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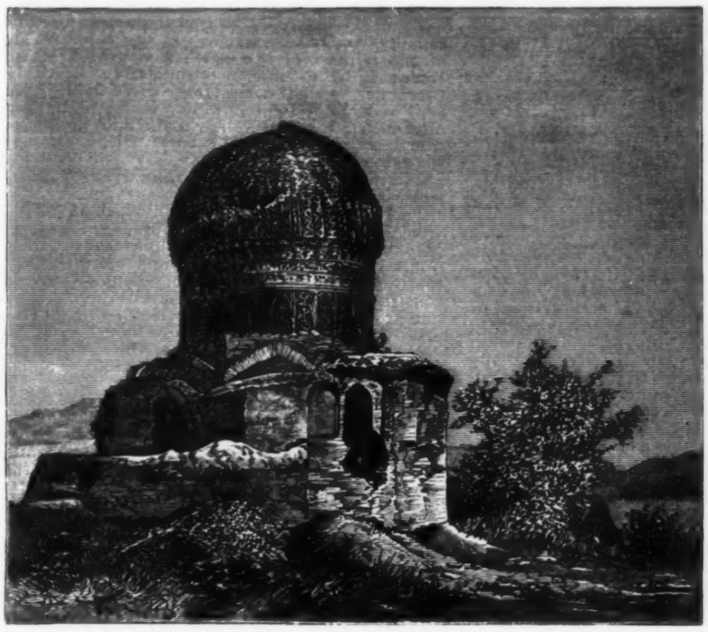
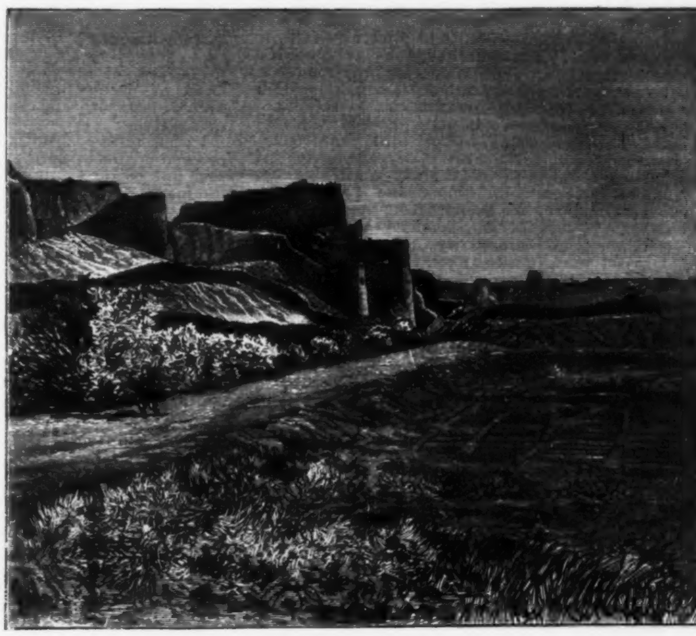
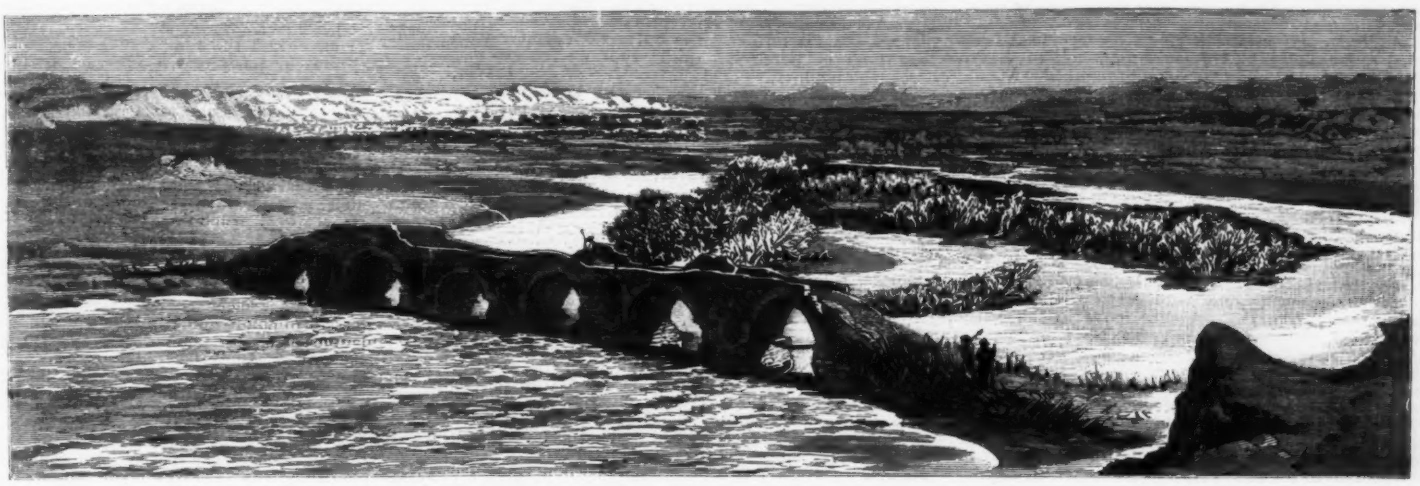


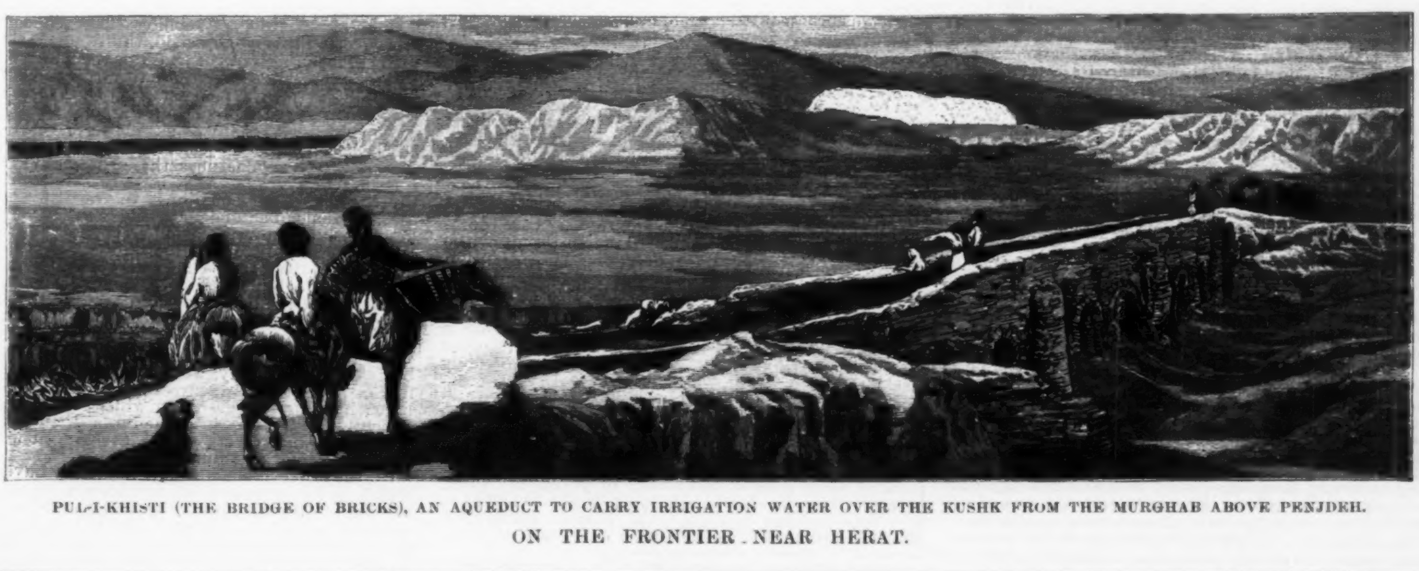
SHAH ROKH'S TOMB BY THE MINAR MASALAH, HERAT.



THE KUSHK GATE, HERAT, ONE OF THE TWO GATES IN THE NORTH FACE.



TIR PUL (THE ARROW BRIDGE) OVER THE HERI RUD, AT THE NORTHERN ENTRANCE OF THE HERAT VALLEY.



PUL-I-KHISTI (THE BRIDGE OF BRICKS), AN AQUEDUCT TO CARRY IRRIGATION WATER OVER THE KUSHK FROM THE MURGHAB ABOVE PENJDEH.

ON THE FRONTIER NEAR HERAT.

ON THE FRONTIER NEAR HERAT.

FROM SKETCHES MADE ON THE SPOT BY LIEUT.-COLONEL SIR EDWARD LAW DURAND, BART.

THE recent activity of Russia on the western Afghan frontier has once more directed public attention to the Amir's territories. It may be, as, indeed, has been suggested, that Russia's activity in the Murghab Valley is only a feint to draw off attention from her aims and ambitions in Persia. Though it were doubtless better both for themselves and for mankind that England and Russia should be good friends, it must be remembered that the colossal army of the Czar contains hundreds of officers who are longing for a chance of distinction, and that from time immemorial India has been the most coveted goal of conquerors, and that furthermore a campaign against British India was enjoined on all the Czars to come by the testamentary dispositions of Peter the Great. Doubtless in modern as in ancient diplomatic relations, every one that is not your avowed friend may be regarded as your possible enemy; it is also certain that the interests of England and Russia in Asia continually overlap, so that there arise frequent diplomatic disputes, in the settlement of which the advantage naturally falls to the cleverest head. England has not been behind other States in the production of great diplomatists, but at the present time it is doubtful if any State sends out a more astute set of representatives to safeguard her interests in foreign countries than does Russia. We have seen what they achieved in China a few years ago; we now see how they are daily strengthening their influence in Persia; while their agents in Bokhara and Kashghar never let any opportunity pass of serving their master's interests. Apart from their undoubted talents, the envoys of Russia enjoy one great advantage, which is not shared by the agents of other States. Russia has practically only one line of policy in the East and Far East, which may be described as the "slow and sure progressive." This policy, in the name of the Czar of All the Russias, is persistently and consistently pursued. Another important advantage enjoyed by the Russians in their dealings with Eastern nations is that they better understand the Eastern character than do most of our statesmen. This is only natural, seeing that Russia has not only for many centuries past been in constant and close touch with Turks, Tartar, and Moghuls, but, furthermore, her officials are themselves often half Oriental, and not infrequently actual Tartars. The result of this is that the Russian always fully realizes the moral value of that somewhat indefinable term, prestige.

The year 1884 found Russia on the Tejend River, only awaiting a fitting opportunity to descend upon Merv, and the opportunity seems to have been found in the embarrassment of England in another part of the world. At the beginning of that year the long-pent storm in the Soudan had burst, and all Europe believed that great troubles were in store for us in that quarter. Whether it was the result of a preconcerted plan or a mere coincidence, it is, at any rate, a fact that at this precise juncture Alikhanoff received orders to start for Merv and demand its submission. On February 4 Baker Pasha's army was annihilated at Tokar, and on February 15 M. de Giers officially informed our ambassador of the submission of Merv. Marvin, who, on account of his pronounced Russophobia, is not always to be trusted, after studying all the documents, official and unofficial, relative to the Russian occupation of Merv, wrote as follows: "The swoop upon Merv was no haphazard event. No local reason whatever provoked it. Russia was not forced to occupy Merv by any circumstances on the spot compelling her against her wish to violate her numerous assurances to this country."

Remembering this coincidence in the past, it is not surprising that a ready ear should have been lent by alarmists to reports from St. Petersburg, recently circulated, that the military authorities in Russia were intending to profit by our temporary embarrassments in South Africa to make a further move in the direction of India. Officially nothing has been made public, but we have been led to believe that such a course was indeed urged by the Russian War Ministry, but that it met with stern disapproval on the part both of the Russian Foreign Ministry and of the supreme power in the empire, the Czar himself. However well-timed or ill-timed such a move might have been for Russia, it is not improbable that we are indebted to the Czar and to his earnest desire for peace in having averted, at least for the present, a situation which would at this moment be especially embarrassing.

The advance of Russia in Central Asia, in spite of fierce battles fought, and in spite of pledges given and broken, may be compared to the gradual and natural advance of a glacier. When General Skobeleff defeated the Akhal Tekkes, it was obvious that Merv too must one day be absorbed by Russia. Russia would have been more than human had she voluntarily stayed her advance after she had taken but a few steps; and surely England can have little reason to complain, or protest, so long as the independence of China, Afghanistan, and Persia is left intact. Moreover, no one can deny that the Russian occupation of Transcaspia and Turkestan is an unmixed blessing for those countries.

Should Russia and England ever come into collision in Central Asia, the campaign would probably begin in the neighborhood either of Herat or Kandahar. The locality would no doubt depend on the attitude adopted by the Afghans, who, if war were declared between Russia and England, would be chiefly influenced by the relative prestige enjoyed by either power in their eyes. And here one cannot help feeling that Russia has the advantage; for while on the one hand they have seen the English enter their country, and then again withdraw, an action they could only interpret as a proof of weakness, they know the Russians to have made in a few years a rapid advance in the direction of their own country, and to have effectually subdued populations famous for their bravery. It has, however, been our policy to make the Afghans feel that as our friends their independence is secure, and that we would fight with them for the maintenance of it. Moreover, we are convinced that at the present time, under a viceroy who has a unique personal knowledge of the country and people, our interests in Afghanistan are receiving the fullest attention. It is well to bear in mind that the Afghans are by no means a united nation, and that although in times of peace the Amir may be regarded as representing his people, an outbreak of war might result in great internal discord and division of sympathies.—For our engravings and the above particulars we are indebted to The London Graphic.

THE SYMBOLISM OF THE ARAPAHO INDIANS.*

THE paper which I am about to present is the result of field work carried on in Oklahoma Territory during last summer among the Arapaho, one of the westernmost tribes of Algonkwian stock; and I may say that in general culture and mode of life the Arapaho resemble most closely, perhaps, the tribes of Siouian stock.

The decorative art of the Arapaho is in no way noted for close realism, nor even for beauty of purely ornamental design. Pottery is unknown, and basketry is practically so; and, in fact, there is no textile work of any account. Bead work is, perhaps, most common now, but porcupine quills and corn-husk, and materials of that sort, are still used for embroidery. There is a certain amount of painting on hide, or wood, or buckskin, according to circumstances; and bone, and especially wood, are sometimes carved, especially in low relief or in outline; and, finally, feathers and fur, and objects of that sort, are considerably used in decoration.

I wish, however, not to speak of the technological, or even of the æsthetic side of the Arapaho decorative art, but of its symbolism. It is almost certain that among the Arapaho, at least, everything that we are wont to call an ornament is a representative of an act somewhat remote. Some ornaments are clearly realistic; at times, certain animals suggesting the bear or turtle are easily recognizable, even when considerably conventionalized; but it is safe to say that every design which is used, however conventionalized or however geometric, is, above that, a picture or a symbol of something. The fact that it is sometimes impossible to very clearly identify the object represented, or obtain an explanation from the Indians themselves, really proves little or nothing, owing to the normal unwillingness of the Indian to communicate to comparative strangers or to foreigners anything of a religious or private nature, as the ornamentation always is. An Indian will hardly ever even guess, or express a guess —hazard a guess—at the meaning of a design which he has not personally made, or seen made (for instance) in his family. Even in that case he is generally unable, and still more often unwilling, to express an opinion as to the meaning of it. The Arapaho themselves admit the significance of all their designs. A young Indian once said to me, "We make nothing without a reason." He meant by that, that every ornament was made as the representation of something, and also that it was made with a definite purpose; but beyond any admissions or claims, the decorations of the Arapaho have almost invariably a connection with the religious life, which is, of course, evident in the case of symbolic patterns or implements used in the dances, but there are other cases. When the buffalo robe was ornamented (as was formerly the universal custom) with long lines of porcupine quills running transversely across the blanket, the design was traced, after prayer, seclusion in a tent and sacrifice, by certain of the older women who were set apart for that purpose. When the hide bag used for preserving dried meat was painted, it was done by four old women sitting alone, and no one else was permitted to do so; and the design painted had reference to a mythological being, the Priest Woman and the Ruler of the Whirlwind. A small dog as used with a lizard shows the first men were compelled to use the skins of these animals for their paint pouches. Ornamentation and symbolism are as regularly religious as the religious feeling seems to regularly find expression in symbolism.

It is, perhaps, owing to this connection between symbolism and all that is included in the term religion, that we find a number of symbols for abstract ideas among the Arapaho. One of the most frequent of these is the symbol for what is called by the Indians "thoughts," and that consists, generally, of a number of straight, vertical lines. They are on a level below and of varying length above. Each of these is supposed to represent a thought, or, perhaps, in some cases, a wish or a desire. Sometimes, when the object to be ornamented does not allow of that treatment, we have them in lines such as this, with a short interval between; but this is the more ordinary arrangement. I remember one case of a bracelet or armlet which was ornamented with a design representing the buffalo; and hanging down from that were three or four strings of about that length, and at the end of these were little tin trumpet-like affairs which are frequently used by the Indians now in place of the old deer hooves and buffalo hooves which were attached to various hanging objects, to pendants, and used as rattles. Now that they cannot get these, they use these little tin tubes and generally have a tuft of hair in them.

These streaks in this other illustration, with the correspondence of these lines, are the thoughts or desires; while these little ornaments at the base represented the accomplishment of the desire; that is, the fulfillment of a prayer for buffalo. The attention which it is desired shall be paid to the prayer or the wish is generally represented by an arrow; and the symbolism there is rather clear, I think. The sharpness of the arrow denotes the close attention which is to be paid; and the course of a message, of a thought or prayer, up to heaven, is sometimes represented by disks on a string running along the length of the object, sometimes along an arrow.

Then there are other abstract symbols having relation to life. One, which is very frequent, is called by the Indians (that is, those of them that speak English) the four divides or hills of life, and consists of four parallel white lines of bead-work or porcupine quills, each of which has four small black breaks or marks in it. The Indians imagine that normal human life (which they consider to be about one hundred years) consists of four growths; so that when a man has reached the age of fifty he has passed over two of the four hills of which life is made up, and each of the four breaks represents this. Finally, we have another symbol for life, or, more particularly, marriage, which is as follows: This represents the beginning of life and its course in this direction, this being the youth of the man and the flaring line representing married life (the larger part of life); and the same symbol, shortened a little, perhaps, is used to represent the Milky Way, the Bear (which is single), and then the remaining part, which is falling, or double.

Colors are rather accessible to the Arapaho and are frequently used by them. Sometimes the symbolism of the colors agrees pretty well with the design and is used to supplement it and make the design or ornament more realistic. In other cases, however, we seem to have in the same ornament two different sets of symbols, one expressed by the design and the other expressed by the colors alone; and in that case, the colors have no reference at all to the other objects which are represented. In this case the colors have a general meaning, red representing humanity in general, on account of blood sometimes and sometimes on account of the red paint still so frequently used. Occasionally, too, red may represent the earth on account of the redness of the earth (the region which the Indians inhabit) and also on account of the paint, the ocher, which comes from the earth; but ordinarily red stands for mankind. Green is the earth, for obvious reasons, and yellow is daylight; while blue of course is the sky, when it occurs. Black may represent the same as blue; or it is often given to objects which are supposed to be shadows, that is, spirts, unreal objects.

There is one particular symbol which involves colors which I want to illustrate, because it brings in several points. I have spoken of the lines made of porcupine quills running across every blanket (or formerly used to) to the number generally of about twenty. These consist for the main part of beads or quills dyed yellow and are interspersed by short lengths of different colors. The middle, for instance, would be red; and on each side of the red there was a white area which was bounded by two narrow black lengths, and in the course of the line (Ihave magnified this very much) there might be three or four or five of these ornaments, the main part of each line being yellow; and then there would be twenty of these lines, one above the other, and these lines in general represent buffalo trails. We have a similar ornament in bead work, where the lines are widened and made contiguous, of different colors, in which we have each band representing a buffalo trail, or sometimes the trail of a camp moving; while these white and red bands will form another band in the opposite direction, which, however, represents a trail, or sometimes ravines and camping places; but in the typical line which was used for these blankets (where this line represents a buffalo trail) we also have the four colors (that is, yellow, black--which I have left blank—white and red), as they represent the four generations of which the world is supposed by the Arapaho to consist: the generation, as I have said, is a hundred years, and we are living in the fourth generation since the beginning of the world according to their account; and the four generations, used as the four divisions or parts of life, are very frequently represented in the symbolic way. In this case the four colors have no reference at all to it: each color has no reference to a particular generation, but the mere fact that there are four colors—the abstract idea that there are four colors—stands for the idea of four generations. This same ornament of yellow, black, white, black, then a larger red, then black, white, black again and yellow, is found in the circular ornaments (generally of bead-work) which are attached to the top of the tent or tepee.

We have, next to the red, a narrow black line, then a white area and the same over here; and then the rest is all filled in with yellow and the same on the other side. It is clear that we have here the same arrangement of colors and the same combinations: we can imagine the circle as one of these lines bent around so that the ends may meet again: we have yellow, then a narrow black, white, black, then the red (not as warm as the yellow), then the white, black, and white repeated again, and then the yellow ones again. The whole thing represents the sun; and that is represented by the circular shape and by the prevailing yellow color; while the red represents the two ends of the day (when the sunlight is not yellow, the sun is red), while the black and white forms a sort of cross which is the regular symbol for the Morning Star, which also announces the sun; and we can have this design, with a very slight modification, take altogether a different meaning. We have black, concentric circles covering this yellow field, the same design, as explained, meaning not the sun, but the whirlwind.

We frequently have a number of symbols on the same object. On a moccasin, for instance, generally we have at least three or four different symbols; and often there are as many as six, eight, or ten even, and similarly on other objects, and even sometimes on larger objects. Sometimes these different symbols fit together pretty well; that is, they give a sort of connected story; but sometimes the very reverse is the case. I remember one moccasin with a very simple design, which, however, had a good deal of meaning. It consisted simply of a stripe running over the instep down to the toe, perhaps four or five inches long, which represented a buffalo trail, as a single band, or any band, ordinarily does. In the center was a green oblong, said to be the buffalo going along the path; here was a narrow, red strip in this fashion, and that was the bow of the hunter who was hunting the buffalo; while, finally, we had small, black, triangular marks here—that is, arrow-points, with the barbs here; here little pincushions, which signify the arrows which had been shot into the buffalo; so that with a little color and a very simple design you would still have a coherent meaning.

On the other hand, we very frequently have symbols which, as far as we can see, can have no possible connection at all; and another moccasin, the background of which was white, was explained as being so; besides that, it contained several large, green areas, which represented the earth and woods green in the spring or summer, and also contained symbols of the dragon-fly and a symbol of a Cœur d'Alene man, a symbol of cat-

* An address delivered December 27, 1899, at the Psychological Laboratory of Yale University, before Section H, Anthropology, of the American Association for the Advancement of Science, by Mr. A. L. Kroeber, of New York.

erpillars, a symbol of a star. I think that was all. Of course, it is not very easy for us to see any connection between these various symbols; but it is probable that there is some underlying coherence between them, and may be due—in fact, it is probably the case—that it was all seen in the dream of the Indian woman who made the moccasin; and that is the reason we have this curious conglomeration.

I wish once more to emphasize the fact that among these Arapaho (and the same point has been brought by Dr. Boas, who preceded me) everything that looks like an ornament pure and simple, and a decoration pure and simple—while it may have to the Indian, even, decorative and ornamental value, and while we might suppose it to be purely ornamental—has, at bottom, a realistic meaning; and the further fact that, perhaps invariably, this decoration and ornament has a connection with religion.

[Concluded from SUPPLEMENT, No. 1296, page 20777.]

POISONOUS SNAKES AND SNAKE POISON.*

By GUSTAV LANGMANN, M.D., of the Department of Pathology, College of Physicians and Surgeons, Columbia University, New York.

IT may be considered as firmly established that snake venoms affect the motor ganglia of the anterior horns and chiefly the medulla oblongata. There exist records of few accurate microscopic examinations of all organs after snake poisoning. In general they resemble the changes which we are wont to find in all kinds of poisoning of whatever origin, especially by the toxins of zymotic diseases, e. g., fatty degeneration of the liver with inflammation of the bile ducts, acute parenchymatous nephritis, disseminated pneumonic patches, etc. Of the pathological changes in the central nervous organs, which, to judge from the symptoms, we may expect to find, no reliable records have been published. I am glad to say, therefore, that several gentlemen of this city have been working up some cases of snake poisoning, and they will give us later an analysis of their investigations. In the mean time, I may be permitted to state the substance of the results as a pronounced affection of the ganglion cells throughout the central nervous system, especially in the medulla; the chromatic structure and cyto-reticulum have almost disappeared, as well as the dendrites; the nucleus and nucleolus are not affected.

The question, then, whether snake venom is a nerve or blood poison seems to be definitely settled: it is both. We have, however, in this connection to consider separately some remarkable phenomena in the blood and circulation. In like manner the multiple hemorrhages might point to a disturbance of the vasomotor center, and some investigators ascribe them to an enormously increased diapedesis. Fresh poison added to blood in a test tube or administered hypodermically causes the blood corpuscles to swell and allows the hæmoglobin to escape into the plasma. The hæmoglobin itself is not changed, the spectrum remaining normal. Local application of poison to a capillary area incites a vigorous diapedesis, as some consider it, while others think it to be a real rupture of the capillary walls. The blood cells escape and are destroyed to such an extent that a few hours after the injection of poison but one-half of the normal blood corpuscles are counted. Finally, however—and this point has been creating a most lively discussion—the coagulability of the blood is materially influenced. Formerly it was an accepted dogma that cobra venom increased and viper venom inhibited clotting; recently, however, the investigations of Heidenschild, and more so the careful experiments of Martin, of Sydney, have cleared up the matter. It is true that viper venom has a more pronounced influence upon the circulation, yet the doses and the mode and the rapidity of introduction are matters of the greatest importance. As a rule, coagulation is inhibited for a long period. A small dose injected intravenously causes a positive phase of coagulability of two or three minutes, which is followed by a negative phase of longer duration. A second larger injection brings on the same positive and a much longer negative phase. A third still larger injection, which is borne remarkably well, destroys coagulability for a long period. At the same time the leucocytes disappear almost entirely from the circulating blood; they are massed in the liver, lungs, and bone marrow, and reappear only when the blood regains its coagulability (or perhaps inversely). A hypodermic injection, and therefore the majority of all snake bites, acts in the same way as a small intravenous injection. Immediate introduction of a larger quantity of poison into a blood-vessel may cause a sudden complete clotting of the whole mass of blood, with the exception of that in the pulmonary veins and the left heart. Many contradictory reports of the blood pressure, sudden stoppage of respiration, etc., are explained by the sudden massive thrombosis. The immediate cause of coagulation is probably a nucleo-albumin, analogous to the fibrinogenic substance of Wooldridge, also a nucleo-albumin. It is not performed in the venom, but, as Martin has it, is liberated instantaneously by the action of the poison from the stroma of the destroyed erythrocytes and the endothelium of the blood-vessels, and it brings on extensive thrombosis at one stroke.

Another important effect of snake venom is the loss of the germicidal property of the blood plasma. It is well known that most normal blood serum destroys micro-organisms, or at least retards their growth. Ewing, of Washington, was the first to show in 1894 that this faculty was annihilated in the blood of animals killed by crotalus poison, and Martin has confirmed it for the venom of the Australian black-snake. This explains both the well-known rapid putrefaction of the poisoned organs and the danger of subsequent decomposition of the extravasated blood and the resulting sepsis during convalescence. We can create a closer similarity of the two types of poison in an artificial way. Viper venom, when heated to 80° C., loses its intense action upon the circulation and approaches cobra venom in character. The Australian snakes occupy in this regard an intermediate position, for besides a prominent cobra effect they produce moderate hemorrhage and always hæmoglobinuria. Persons poisoned by the East Indian Bungarus exhibit sometimes a peculiar course of disease. Some cases cannot be distinguished from cobra poisoning, yet in others a certain chronicity of symptoms is seen, which can be compared only to the incubation period of infectious diseases. From two to six days may have elapsed after the bite without any symptoms, when unexpectedly a general debility sets in, with albuminuria and a sanious discharge from the eyes, nose, and rectum. The patient invariably succumbs within a short time. A disproportionate swelling is to be noted in poisoning by the European viper; it sometimes extends over the whole body. The poison of the African viper, the puff-adder, acts in a stupefying manner from the very beginning; the animal stricken stands without motion or reaction, as if the whole cerebral cortex was eliminated; complete sensory and motor paraplegia ascends gradually with sharply defined limits. In briefly summarizing the mode of dying from snake poison we might say: Death occurring within a few minutes is due to general thrombosis; a patient who dies within twenty-four hours may succumb in the first hours to paralysis of the respiratory center, later to general paralysis; lethal exitus later than this time, days or even weeks after the bite, may be the result of sepsis.

The object of treatment is fourfold: first, to prevent absorption of the poison; second, to destroy or neutralize it; third, to accelerate its elimination; fourth, to treat symptoms of imminent danger. If the wounded limb, e. g., a finger, cannot be amputated quickly, at least the circulation should be checked or retarded by a ligature as practised since time immemorial. A ligature is applied as tight as possible, not only at one, but at two or three places; e. g., when a finger has been bitten, round the finger itself, at the wrist, and at the elbow. The experienced Wall is so convinced of the advantages of Esmarch's bandage that he not only recommends every physician in India to have one in readiness, but wants to see it in every well-regulated household. The ligature is relaxed at intervals of some hours to prevent gangrene, but is applied again as soon as practicable.

It has been an often-recommended custom to suck the wound with the lips or to apply cups. The result of such a measure is at least doubtful, because of the finely punctured bites; the sucking ought to be preceded by a long scarification into the deeper tissues. It is still safer to excise a large area of these tissues or destroy them with the actual cautery. Wall, taught by long experience, recommends proceeding in the most ruthless manner. By these means the absorption of poison can be limited to a possible minimum, so that the system shall gain time to overcome the whole quantity at intervals. How reliable a good ligature may be is demonstrated by a case reported, in which the effect of a fatal dose was arrested for sixteen hours, but after the ligature was loosened, death occurred within two hours.*

The next question is: Are we able to render innocuous the poison in the tissues surrounding the bite? This leads us to a whole series of specifics, which owe their reputation partly to old traditions, partly to experiments in the test tube. The majority of these specifics, which, it is true, neutralize the poison in vitro after a shorter or longer period (carbolic acid, e. g., only after twenty-four hours), destroy all tissues to such an extent that it seems preferable to apply the cautery. Even the much praised permanganate of potassium, recommended especially by Lacerda, of Rio, has not fulfilled the high expectations, for neither locally applied in a one per cent. solution nor injected intravenously has it the elective faculty to single out snake venom for oxidation in presence of other proteids. One per cent. of chromic acid has gained somewhat of a reputation; it does not destroy the tissues simultaneously with the poison, but it merely makes them shrink. Calmette has frequently tested hypochlorite of lime in a solution of 1:60; he found both its local and repeated hypodermic application as well as its internal administration of good effect; not less so a one per cent. solution of chloride of gold as a local remedy.

Ammonia, extensively used internally and externally, is nothing but a stimulant. Feoktistow actually advises against it, because he thinks he has seen after its use increasing hemorrhages caused by higher blood pressure. Neither has alcohol any local effect as a coagulating medium; it is to be rated also as a mere stimulant. It has always met with appreciation on the part of the real or, more so, of the alleged victim. Indeed, the use of this infallible specific has often been carried to such an extent that it was impossible to decide whether the patient succumbed to snake venom or to an acute alcoholism. It is, moreover, a fact that intoxicated persons, when bitten in this state, have not proved to be better protected against snake bites than sober people; and the enormous doses which we often hear of as having been administered deserve nothing but condemnation.

If, then, the chances of neutralizing the poison in loco are limited, we may ask if we can hasten the excretion of the injurious substance. The kidneys are attacked to a greater or lesser degree by the poison, especially that of vipers; hence, it is doubtful whether we should be permitted to increase their activity. The vicarious excretion by perspiration, stimulated by diaphoretics, has also had dubious results. It has been demonstrated, however, that part of the poison is excreted by the stomach. Alt, of Munich, found that alkaloids, chiefly morphine, after hypodermic use were excreted by the stomach almost to one-half of their amount. When he tried the same method for snake venom, it was discovered that the animals whose stomachs were washed out were saved, whereas the controls died; at the same time the washed-out fluid was again poisonous to other animals. Hence it is probable that the use of the stomach pump may be of good service. Those of you who have read a minute description of or have personally witnessed the snake dance of the Moki and Zuñi Indians of Arizona, will remember that after the performance the dancers who are sometimes bitten by the snakes receive a potion prepared by the priests, which contains an emetic. Then the whole crowd stand around a certain part of the parapet to empty their stomachs freely. This custom has undoubtedly been sanctioned by long experience.

Finally, to settle upon a definite method of rational treatment, it will be necessary to proceed in a regular clinical way, in order to find the proper indications for therapy. What are the prominent morbid changes which threaten life? Are they irremediable or are they transient? That they are not irremediable is proved by the many individuals who survive a snake bite in spite of the gravest symptoms. We have seen that the poison exerts, first, a hæmolytic action; second, a destructive influence upon the cells of the medulla. We know at present of no pharmaceutical remedy which will arrest either the escape of the hæmoglobin into the plasma or the rupture of the capillaries. The effective remedy which we now possess will be spoken of in conjunction with the other groups of symptoms to which we proceed directly. These symptoms we have found to be due to the toxic action upon the central nervous system. The changes in the ganglion cells, the dissemination and disappearance of the Nissl granules, whatever this may mean, must be fully reparable, since, as we have seen, rehabilitation takes place rather suddenly. If we are not able, therefore, to re-establish their function immediately, could we not at least tide over the dangerous period of deep depression? One method suggests itself to a medical mind, i. e., artificial respiration. The heart-beat ceases several minutes later than respiration, and in one experiment Fayrer succeeded in keeping up the circulation for eight hours longer by artificial respiration. Fayrer and Lauder Brunton strenuously recommend that it be continued not only for hours, but for days, with or without a tracheal cannula. This advice seems to have fallen somewhat into oblivion, especially since Martin claims that in poisoning by Australian snakes he saw no good results from artificial respiration, death occurring in spite of it in fifteen minutes after the heart stopped. Notwithstanding some failures, we are justified in trying it for an extended time, always keeping in mind that an abrupt change may set in in the most desperate cases.

In this connection we have to consider a remedy which even recently has been praised with certain persistency as a specific; I mean strychnine. First used by Pringle in Australia, it was tested in India, and in spite of the little encouraging reports was enthusiastically championed by Dr. Muller, of Sydney. He declared the failures were due to insufficient doses, and he began with a dose of at least 0·01 gm., repeated several times until slight tetanic symptoms appeared.*

Many cases in Australia have been treated with strychnine, and upon the advice of the government, Indian surgeons have also used it quite extensively. Nevertheless, the results are not so convincing that we could rely upon this drug as a specific. The experiments of Kanthack and Feoktistow were negative; interesting, however, is the latter's positive experiment that artificial tetanus brought on by strychnine was arrested by snake venom. Roux † states that tetanus antitoxin has a certain influence upon snake poison, but not inversely. Atropine has been recommended as a stimulant for the respiratory center. I do not find many instances of its use recorded, but fail to see why it should not be resorted to as well as strychnine.

A few years ago Calmette, and almost simultaneously Fraser, of Edinburgh, surprised both the scientific and the lay world with an anti-venomous serum. It is to serum therapy and immunization, as we shall presently see, that we have to look for the successful treatment of snake bites.

The idea of immunization is by no means a modern one. Even in antiquity we hear of it, and among savage tribes of ancient and modern times, wherever poisonous snakes abound, attempts at protection against snake venom are made under various forms, sometimes connected with mystic ceremonies.

Sewall, of Ann Arbor, Mich., was the first to introduce methodical inoculation of snake venom with the idea of immunization. His experiments, in which, by gradually increased doses, he made his pigeons secure against seven times the lethal dose of massasauga poison, were published in 1887. Calmette, director of the Pasteur Institute of Lille, France, after a series of failures succeeded in securing immunity and at the same time in elaborating a protective serum, antivenene, which, spite of some weighty opposition, must be considered to-day as the only reliable antidote to the deadly action of snake poison. Calmette manufactures antivenene by inoculating with cobra venom or with a mixture of cobra, crotalus, viper, and hoplocephalus venoms, in both of which the hæmolytic agent has first been eliminated by heating to 80° C. The inoculation of horses has been carried on for three successive years. Antivenene acts as a full protective in a dose of from 5 to 20 c. c., when injected even one and one-half hours after the introduction of venom. A number of reports from different parts of the world attest the curative power of Calmette's antivenene. It has been used with beneficial effect in East India, in Egypt, Africa, and in the West Indies against the different serpents of those countries. Fraser, who worked independently of Calmette for six years on the same subject, does not agree on all points with Calmette; in fact, the latter's statements have not been thoroughly confirmed by the Indian physicians and by Martin, of Sydney.

Phisalix, of Paris, while experimenting exclusively with viper venom, has found many substances which exhibit a decided antitoxic action. First, he discovered in the blood serum of eels a substance which, according to Mosso's researches, has a similar effect to that of snake venom, only that larger doses are required, and in the poison of the Japanese salamander ingredients which serve to immunize against viper venom. Still more surprising was the similar action of cholesterin, separated from biliary calculi and from carrots, or that of tyrosin, separated from bulbs of the well-known dahlia and also from mushrooms. All these bodies, partly of vegetable origin, had a decided immunizing effect against viper venom, and the blood serum of animals into which these substances had been injected had an exactly similar effect. Very likely we have to add to these many vegetable remedies which have had more or less established reputation as snake cures, as,

* Abstract of paper read before the Academy of Medicine, New York, and published in The Medical Record.

* Weir Mitchell: Smithsonian Contribution, 1861, p. 3.

* The tolerance toward strychnine seems to be quite extraordinary in these cases; thus gr. ¾ was used in the case of a boy thirteen years of age within three and three-quarter hours, gr. ¾ in five and one-half hours, gr. ⅞ in four and one-half hours, gr. 1$\frac{1}{10}$ in seven hours, gr. 4 in six days.

† Annales Pasteur, 1894.

e. g., the before-mentioned Micania guacho. All these substances, however, are capable of raising the resisting power of the organism but little above the minimal lethal dose of venom; they have no effect whatever when injected simultaneously with the poison, but if introduced at least twenty-four hours previously they create an immunity of some duration. It must be noted that all these substances are the highest final products of proteid metabolism. I must not forget to mention the similar antitoxic influence of the suprarenal glands, the administration of which is a therapeutic measure recently come into prominence; their cortical substance seems to be more efficacious, and it may be of interest to know that the guinea-pig, which is the animal most susceptible to snake venom, has almost no suprarenal cortex.* It is to be hoped that the action of these proteid substances may lead us to a definite solution of the relation between toxin and antitoxin; and snake poisons, as Martin points out, are particularly well adapted for these investigations. They have the great advantage of being less sensitive than other toxins to light and heat, and of being comparatively easy to obtain in a form which preserves a remarkably constant composition.

To sum up, then, the most commendable treatment would be:

One or several tight ligatures should be made above the wound, followed perhaps by deep scarifications; then injection of antivenene, if at hand. If the latter cannot be had, injections should be made of a solution of hypochlorite of lime, 1 to 60, at several points near the bite and elsewhere. Stimulation, if necessary, by either strychnine or atropine or alcohol; hypodermoclysis of physiological saline solution; lavage of the stomach; artificial respiration for hours; and, not least of all, continuous encouragement of the victim, for a deep mental prostration goes together with the physical depression of the nervous centers.

* Myers: Lancet, 1898, i., 8.

THE DIOCINESCOPE.

IN spite of the wonderful improvements introduced into it, it is manifest that the cinematograph presents numerous inconveniences, the effect of which is to debar the majority from the practice of animated photography.

Embracing a complicated and costly installation, which necessitates special precautions, if it be desired to prevent the danger of fire, which is always to be apprehended in a place in which substances as inflammable as celluloid have to be handled in the vicinity of electric lamps, all cinematographs, even the best constructed ones, present still another defect, which it is impossible to correct, since it is a consequence of the very principle of the apparatus, and that is that the image projected is submitted to extremely disagreeable scintillations, resulting from the necessity of masking the projection objective during the motion of the film between each successive image.

Could not these various annoyances be done away with and the apparatus necessary for the utilization of the cinematographic bands be simplified, and the quality of the projections be at the same time improved?

M. Clermont-Huet, a skillful manufacturer of optical instruments, thinking that the problem was not incapable of solution, has been led, after prolonged studies, to devise a new instrument called the "diocinescope," which constitutes one of the most curious novelties of the Exposition.

This apparatus is not a true cinematograph, but rather a direct vision and continuous motion one, without any stoppage of the film and without shutters.

Requiring no accessory and utilizing for the illumination only the light of day, or that of any lamp whatever, or even that of a simple candle, it owes to its principle, which absolutely does away with the necessity of masking the objectives at certain instants, the property of giving extremely luminous images entirely free from scintillation, after the instrument has once been regulated.

The diocinescope embraces, in principle, three essential elements:

1. A drum upon which is mounted a number of juxtaposed lenses, the spacing of the centers of two consecutive ones of which is exactly equal to the interval between two successive negatives of the band of film.

2. A drum for carrying the negative holders, having the same angular velocity as the one just mentioned, and over which passes the band upon which are formed the negatives corresponding to the different successive positions of the subject.

3. A reflecting system interposed between the two drums, and so constituted as to send successively the image of each negative in the direction of the optical axis of the lens through which it is to be perceived.

Finally, completing those constituent elements arranged and combined in such a manner that the different lenses fixed upon the drum form their images always at the same point, a clockwork movement or a winch actuates a pulley that carries along the film in such a manner as to bring its manifold negatives successively in front of the ocular of the apparatus.

Let us now examine how these various parts of the apparatus are used.

Let *A* (Fig. 1) be the drum upon the periphery of which are mounted divergent lenses, *B*, which are juxtaposed according to segments of common bases in order that no eclipse may occur, and *D* the negative drum, over a portion of the circumference of which the band of film, *C*, passes.

In the interior of the two drums, which have one axle in common, and are operatively connected, is placed a reflecting system composed either of two parallel stationary mirrors, *e* e^1, or, as is the case in practice, of a prism with parallel reflecting faces, and the object of which is, after the double reflection, to permit of normally reflecting at *A* the image of the opposite point, *D*, of the film, *C*, to the lens, *b*, the ray emanating from such point, *D*, having accomplished the passage *D C B A*.

After the film has been carried along and the images of the various negatives have been brought in succession opposite the ocular of the apparatus, the drum, *a* (Fig. 4), presents a piece, a^1, of which the circumference is provided with points designed to engage successively with perforations formed at equal intervals in the edge of the band of film, *c*, of which the other edge rests upon the smooth part, d^2, presented by the disk, *d*, of the negative drum.

This arrangement, which is completed by a system of two spools (Fig. 2), upon one of which, g^1, is wound the supply of film, while the other receives the film after it has passed over the negative drum, is placed in the interior of a small cabinet, the back wall of

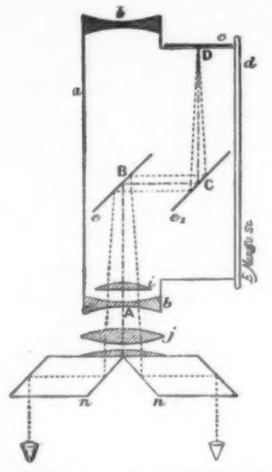


FIG. 1.—PASSAGE OF LUMINOUS RAYS.

which contains a window, *m*, provided with a mirror through which (Figs. 2 and 3) the luminous rays are directed to the band of film in such a way as properly to illuminate it. It will now be seen how the system works.

Every negative of the band of film, *C* (Fig. 1), reaching *D* sends to the face, e^1, of the prism a ray reflected anew at *B*, according to the direction, *B A*, which is exactly that of the optical axis of the lens, *b*. It follows that an eye situated at *A* sees the image of the negative, *D*, according to a direction, *A B*, parallel with *D C*. But, in consequence of the unwinding of the film (the result of which is to bring the rotation to

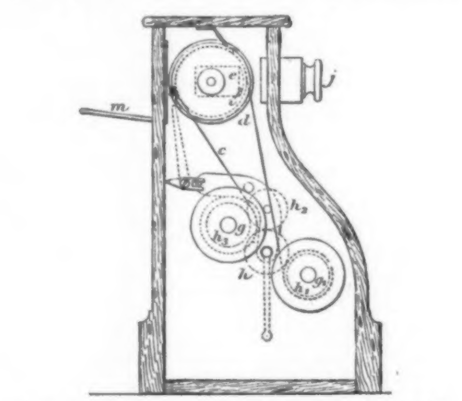


FIG. 2.—DIAGRAM OF THE MECHANISM.

the same angular velocity as that of the lens drum), the various successive images of the photographed scene rapidly succeed one another at *D*. The result is that the eye of the observer situated at *A* sees through the lenses the same images succeeding one another in a parallel manner, and as such images all form at the same point, according to a direction, *A B*, they give the impression of a continuous scene.

But this is not all. As the lenses of the system are, as we have said, divergent ones, the images that they give of the negative passing at *D* are diminished. In order to remedy this inconvenience, the inventor places in the interior of the lens drum, and near the crown of divergent lenses, a stationary convergent lens, *i*, which is of the same focus as the latter, and which consequently compensates for their property of diminishing the size of the images, and which compensates also for the phenomenon of spherical aberration, resulting from the fact that the image of a same point, as a consequence of the rotary motion of the divergent lenses, is given now by the center of the latter and now by a region more or less contiguous to their edges. Now, by reason of the size of the aperture of the lenses, these phenomena of spherical aberration, which have the effect of modifying the value of the focal distance, which then becomes feebler at the edges than at the center, would constitute a grave defect—that of giving animated images of a slight apparent movement, instead of absolutely stationary ones. But, since the spherical aberration of the stationary lens, *i*, is of a direction exactly opposite that of the movable

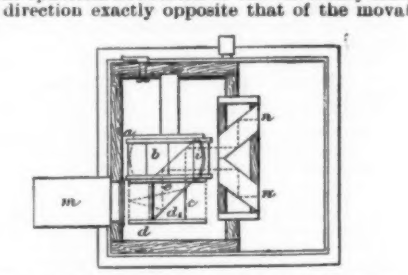


FIG. 3.—HORIZONTAL SECTION OF THE DIOCINESCOPE.

divergent lenses, this prejudicial effect is absolutely corrected. Nevertheless, with such an arrangement, the observer placed at *A* perceives the images in their natural size, which is, as we know, extremely reduced. In order to increase their apparent dimensions and permit also of employing both eyes in the examination of the animated scenes, M. Clermont-Huet has arranged in front of the lens drum a compound lens, *j*, combined with two double reflection ocular prisms, *n* n^1, the reflecting faces of which are parallel (Figs. 1, 2 and 3).

Such is, in its broad lines, the diocinescope, an instrument which, as may be seen, recommends itself by its great simplicity. The apparatus, which is of exceedingly strong construction, and the regulation of which is not easily deranged, is reversible, that is to say, it permits of causing the film to move in one direction or the other by throwing, through a simple plunger, the motor wheel, *h* (which is actuated by

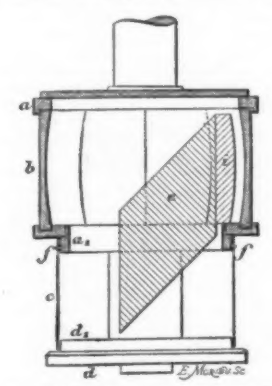


FIG. 4.—DETAILS OF THE DRUMS.

clockwork or a winch), into engagement either with a wheel, h^1, keyed upon the shaft of the drum, g^1, or with a wheel, h^2, keyed upon the shaft of the wheel, g^1.

The maneuvering of the diocinescope, which presents the great advantage that there may be used with it all those bands that are provided with what are called "American perforations," and that it does not strain and tear these as do apparatus in which the traction is intermittent, is very easily effected.

After lifting the spring of the black spool (Fig. 5) and sliding the extremity of the film beneath, the spring is slightly pressed with the thumb. The film being then fixed, is wound around the spool. This preliminary operation being finished, the spool is mounted upon the shaft designed for its reception, and then the film

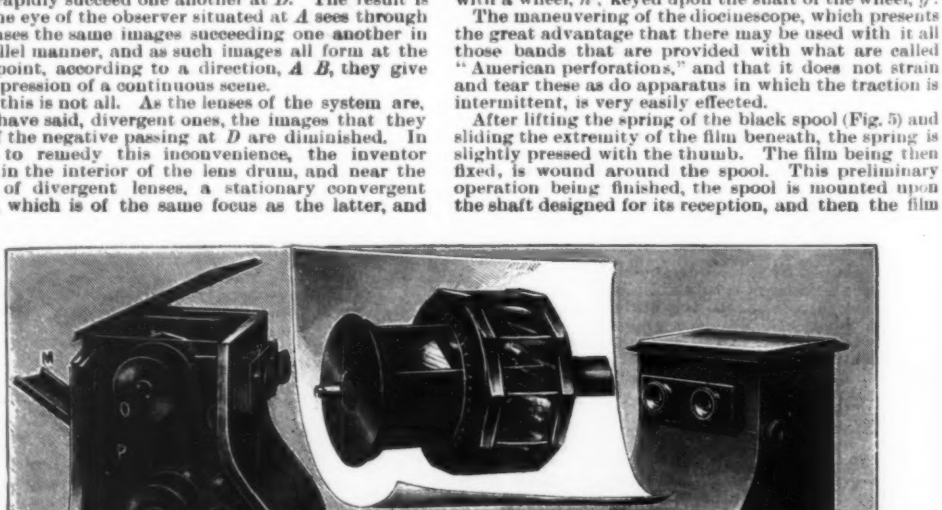


FIG. 5.—THE DIOCINESCOPE.

1. The apparatus open. 2. The apparatus closed. 3. The lens and negative drums.

is passed, shining side upward, over the negative drum, a, care being taken at the same time to introduce the teeth into the perforations of the band.

This done, the other extremity of the film is slid under the spring of the white spool, g'; and, the door of the apparatus being closed, a proper inclination is given to the reflector, *m*, which is designed to illuminate the image to be observed.

Finally, placing the eyes before the oculars, we assure a perfect focusing by means of the button, *A*.

Things being thus arranged and the needle of the apparatus having been placed upon the indication "forward," either the clockwork movement that actuates the system is thrown into gear or the winch is turned by hand; then, after the band has entirely unwound, by placing the needle upon the indication "backward," the black spool is thrown into gear in its turn, and the scene which has been observed normally is unwound in an opposite direction.

These latter operations, moreover, in apparatus installed in exhibition halls may be performed automatically, the double disengagement for the forward and backward motion being effected through the introduction of a coin through a slot provided for the purpose.

Constructed in the manner that we have described, the diocinescope acts solely as a cinematoscope and permits only of a direct view of the images. Nothing would be easier, however, than to convert the same apparatus into a cinematograph for projections, or into a chronophotographic apparatus for the registering of negatives upon the band of film.

In the first case, in fact, it would suffice to substitute a projection objective for the lens used for a direct examination of the images, and, in the second, to replace the lens by a photographic objective to which would be added a shutter that would regulate the time of exposure necessary for each view, being given the speed of unwinding of the film. In this latter case in particular the apparatus would have to be closed hermetically, so as to prevent the introduction of any light capable of clouding the film.

As may be seen, the diocinescope, which may likewise be so constructed as to be stereoscopic and permit the operator to see simultaneously two images taken at the same time and thus to obtain a perfect sensation of relief, forms a most interesting contribution to the study of animated photography, since it renders the latter more easily accessible to numerous amateurs, and, what is no less important, constitutes a most happy improvement upon apparatus that have proved thoroughly defective despite the ingenuity of their skillful inventors.—For the above particulars and the illustrations, we are indebted to La Nature.

COMMERCIAL USES OF BIRDS.*

BIRDS are utilized in a variety of ways. Some species are valuable for food, a few as egg producers, others for plumage for millinery purposes, and still others for their guano. An immense trade has sprung up in game, feathers, and guano, and our markets draw their supplies from all parts of the world. Aside from its purely commercial aspect, this traffic is important in its relation to agriculture. Most game birds are useful to the farmer, and their preservation is important not only because of this fact and on account of their market value, but also for the purpose of protecting smaller insectivorous species which otherwise are likely to be destroyed to supply the increasing demand for game. The millinery trade has already practically exterminated several native species, and as plume birds become scarce, insectivorous birds are utilized in increasing numbers. Finally, to the development of the guano trade agriculture owes much of the advance which has been made in the modern system of intensive cultivation and the intelligent application of fertilizers.

GAME.

Accurate statistics regarding birds and bird products are difficult to obtain, but the increase in this trade has had a marked, and in some cases a disastrous effect on certain native species. The number of birds annually killed for game in the United States has increased largely with the development of railway systems and the perfection of cold-storage facilities for shipping game to market. Quantities of game are frequently kept in cold storage for months at a time, or even from one season to another, so that our large cities can now receive their supplies not only from neighboring regions but from distant States and even foreign countries; for instance, South American tinamous, shipped from Argentina to London, and then imported into this country, have been sold in the markets of Washington, D. C., having thus been necessarily kept on ice for several months. New York, Baltimore, Boston, Chicago, St. Louis, New Orleans, and San Francisco are all large game centers, and the quantity of birds annually sold in any one of these cities is simply enormous. D. G. Elliot, writing as long ago as 1864, states that one dealer in New York was known to receive 20 tons of prairie chickens in a single consignment, which were estimated to represent 20,000 birds, and that some of the larger poultry dealers sold from 150,000 to 200,000 game birds in the course of six months. "These estimates," he adds, "so far from being exaggerated, are probably far below the true state of affairs, and these, it must be recollected, are but the receipts of a single city. The total number of birds destroyed throughout the country would exceed the credibility of everyone."*

The consumption of game to-day is much greater than it was thirty-five years ago, and the effect of such enormous slaughter has become very apparent in the case of several species, as, for example, the pinnated grouse, or prairie hen, and the passenger pigeon. The prairie hen (Tympanuchus americanus) occurs on the prairies of the Mississippi Valley from Louisiana and Texas north to latitude 50° in Manitoba, and from northwestern Ohio and southwestern Ontario to central Nebraska and Kansas. In the East its range is rapidly contracting; a few are still found in Kentucky, but the species is rare in Indiana and northwestern Ohio. It usually lays from 11 to 14 eggs in a set, and is considered one of the most prolific of game birds, ranking next to the bobwhite in this respect. But in spite of this and the fact that the bird is gradually extending its range westward with the settlement of the country, the species cannot maintain its normal abundance in the face of the destructive agents against which it has to contend.

Audubon states that when he first moved to Kentucky (about 1808) prairie hens were very abundant, and could be seen frequently in the farmyards with the poultry and even in the streets of the villages. So little were they esteemed as game that hunters scarcely deigned to shoot them, and they could hardly be sold for more than a cent apiece. A quarter of a century later he remarks that the grouse had practically abandoned the State of Kentucky, and each year their limit of abundance was moving farther westward.† A few are still found in the State and in many sections of the prairie region of adjoining States, but they are no longer abundant east of the Mississippi River.

A still more striking case of extermination is that of the passenger pigeon (Ectopistes migratorius), which has been reduced almost to the point of extinction except in two or three Northern States. This species formerly ranged over the deciduous forest region of eastern North America, from the Gulf of Mexico to Hudson Bay, and was remarkable for the enormous numbers which often collected together. To-day its breeding range is restricted to the thinly settled wooded region along the northern border of the United States, chiefly in Michigan and Wisconsin. It was one of the first birds to attract the attention of early colonists, and references to it may be found as far back as 1630.‡ The enormous breeding colonies and roosts and the great flights, such as that seen by Audubon in 1813, afforded an abundant supply of food, and the birds were slaughtered by the million. Audubon speaks of seeing schooners at the wharves in New York in 1805 that were loaded in bulk with pigeons taken on the Hudson River, and states that the birds sold for only a cent apiece. In March, 1830, he found them so abundant in the New York markets that piles of them could be seen in every direction. He purchased 350 live pigeons at 4 cents apiece, most of which were carried to England. Prof. H. B. Roney has described a breeding colony located near Petoskey, Mich., in 1878, which covered about 100,000 acres of land, and from which it was estimated 1,500,000 dead birds and 80,532 live birds were shipped by rail, and probably an equal number by water. He estimates the total destruction of pigeons in Michigan in 1878 at 1,000,000,000, an estimate probably in excess of the number actually killed.*

The passenger pigeon has long since ceased to have any commercial importance; the netting and the slaughter to which it was subjected at its roosts and breeding grounds have almost exterminated it. According to Brewster, the last important nesting in Michigan took place in 1881, a few miles west of Grand Traverse.† In the last twenty years the species has decreased so rapidly that its occurrence in any of the States except Indiana, Michigan, Minnesota, and Wisconsin can hardly be considered more than accidental.

Although the wild pigeon is now protected by law at all seasons in Michigan and Ohio, it is doubtful whether it can be saved from extinction. Like the bison, it has been sacrificed through wasteful and useless slaughter.

EGGS.

Large colonies of water birds, such as murres, pelicans, gulls, terns, and herons, may be found at certain points along our coasts during the breeding season. The value of these birds has never been properly appreciated, although in certain localities eggs of some species are highly esteemed and find a ready market, as on the eastern shore of Virginia, where eggs of the laughing gull (Larus atricilla) are considered a great delicacy and are gathered in large numbers for sale to hotels and private individuals. But in the gratification of this taste there is the same tendency toward extermination which is manifested in the case of feather collecting.

Scott refers to the extermination of gulls and terns near the mouth of Tampa Bay, Florida, brought about in part by the operation of the market egg hunters in the early eighties.‡ Sennett, in speaking of the quantities of eggs, chiefly of gulls, terns, and herons, gathered a few years ago along the coast of Texas, says:

"There is probably not a port, pass, or bay on the entire coast of Texas whose inhabitants do not regularly devote several days each year to what they term 'egging.' . . . All eggs from an inch in diameter upward are taken, excepting perhaps those of the pelican, whose eggs are too fishy for any stomach. I have known of boats which came a distance of over 100 miles to gather these eggs, cruising from reef to reef until they secured a good load. For days after the return from these expeditions the shops along the coast expose quantities of birds' eggs for sale, which are disposed of cheaply, according to size. . . . In regard to the profits of the 'egging business,' I doubt if even the most successful 'egger' can make as much money as he could have done had he stuck to his regular and much more praiseworthy occupation."‖

The eggs of the "arrie" or "Pallas" murre (Uria lomvia arra) are collected for food on the Pribilof Islands, in Bering Sea, and H. W. Elliott mentions that on the occasion of his first visit to Walrus Island, in July, 1872, six men in less than three hours loaded a badarrah carrying four tons with eggs to the water's edge.

On Laysan, one of the northwestern Hawaiian Islands, the "gooney," or albatross (Diomedea immutabilis), fairly swarms. Immense quantities of its eggs

COLLECTING GOONEY EGGS ON LAYSAN ISLAND, H. I.
(Photograph by J. J. Williams, Honolulu.)

* From "A Review of Economic Ornithology of the United States." By T. S. Palmer, Assistant Chief of Biological Survey, United States Department of Agriculture, and forming part of the "Yearbook" of the Department for 1899.

* Rept. Commr. Agr., 1864, pp. 383 and 384.
† Ornith. Biog., II, p. 491, 1835.
‡ See Merriam's Birds of Connecticut, pp. 93-94, 1877.

* Am. Field, X, pp. 345-347.
† Auk, VI, pp. 285-291, 1889.
‡ Auk, V, pp. 377, 1888.
‖ Science, VII, pp. 199-200, February 26, 1886.

are gathered for the use of the employes of the guano company, and possibly some are shipped to Honolulu. Photographs show that the eggs are gathered not only by the wheelbarrow load but by the car load. (See engraving.) Formerly, it is said, the birds were accorded rigid protection by the superintendent of the company, but how long they can survive the recent wholesale removal of eggs is not difficult to surmise.

A still more striking example of wholesale egg collecting, and probably the most important one in the United States from a financial standpoint, is that of the Farallones. These islands, or rather rocks, situated on the coast of California 30 miles west of the Golden Gate, are the breeding grounds of myriads of sea birds, chiefly western gulls (Larus occidentalis) and murres, or California guillemots (Uria troile californica.) For nearly fifty years murre eggs were collected here and shipped to the San Francisco market, where they found a ready sale at from 12 to 20 cents per dozen, a price only a little less than that of hens' eggs. During the season, which lasted about two months, beginning near the middle of May, the eggs were shipped regularly once or twice a week. The main crop was gathered on South Farallone, the principal island, and mainly from the "great rookery" at the west end. The birds lay only one egg, which is deposited on the bare rock. When the season opened, the men went over the ground and broke all the eggs in sight, so as to avoid taking any that were not perfectly fresh. The ground was then gone over every second day, and the eggs were systematically picked up and shipped to market.

The business was in the hands of Italians and Greeks, who were also engaged in fishing, and although only a dozen or fifteen "eggers" were employed on the islands, the number of eggs gathered was simply enormous. It is said that in 1854 more than 500,000 were sold in less than two months, and that between 1850 and 1856 three or four million were taken to San Francisco. Dr. Heermann states that the value of the traffic was between $100,000 and $200,000, evidently too large an estimate, even at the high price of eggs prevailing at that time. Since then the value of the eggs has declined, and the number has also fallen off considerably. In 1884 there was gathered 300,000; in 1886 about 108,000; while in 1896 the crop was reduced to a little less than 92,000.

The Farallones being a government lighthouse reservation, the "eggers" were allowed on the islands by sufferance. From 1850 to 1880 the Farallone Egg Company remained in almost undisputed sway, but were dispossessed in 1881 by the lighthouse authorities. Afterward the keepers hired men to gather the eggs, but in 1897 the attention of the Light-house Board was called to the decreasing numbers of birds, and instructions were promptly issued prohibiting further gathering of eggs for market, thus practically putting an end to the business for the present. Full accounts of the methods employed in this remarkable traffic may be found in the interesting papers of Bryant and Loomis,* from which the above facts have been mainly derived.

FEATHERS.

The fashion of wearing feathers and birds on hats has increased to such an extent during recent years as to cause an immense demand for birds and plumes to supply the millinery trade. The saying that a bird which has become fashionable is doomed to almost certain extinction is exemplified by the great decrease in numbers of terns along the Atlantic coast and herons of the Gulf States within the last twenty years. Attention was called to this wholesale destruction by the American Ornithologists' Union in 1886,† and the devastation of the Florida heronries and the barbarous methods of the plume hunters were vividly described by Scott in 1887 in a series of papers entitled "The Present Condition of Some of the Bird Rookeries of the Gulf Coast of Florida."‡

Terns of several species were formerly abundant along the coast from Florida to New England. The common tern (Sterna hirundo) and the least tern (S. antillarum) bred abundantly on the New Jersey coast, but, according to Stone, both were nearly exterminated about 1883 to supply the millinery trade. As an example of the wholesale destruction of birds, Scott mentions a contract made by two men on Tampa Bay, Florida, for the delivery of 30,000 terns in a single season. Similar contracts have been made on the coast of Virginia; and from Seaford, Long Island, N. Y., more than 3,000 terns were sent to market during the summer of 1883 by one gunner and his associates, while about the same time 40,000 are said to have been killed on Cape Cod, Mass. The results of such slaughter were swift and sure. An examination of the grounds about the mouth of Tampa Bay and the bars off Pass Agrille, on the west coast of Florida, in the summer of 1888 showed that not a tern of any kind was breeding where countless numbers had nested only a few years before.‖ Of the northern coast, Chapman says in 1895 "this little barren, uninhabited sand island [Gull Island, off Long Island]—only a few acres in extent—and Muskeget Island off the Massachusetts coast, are the only localities from New Jersey to Maine where the once abundant common tern, or sea swallow, can be found in any numbers. [Each of these islands now has a keeper who is paid to protect the terns.] What an illustration of the results of man's greed and woman's thoughtlessness!" §

But the destruction of herons has been, if possible, even worse. The only heron feathers of any value are the nuptial plumes, commonly known as aigrettes, and in order to secure these plumes at their best the birds are killed on the breeding grounds soon after the eggs are laid or the young hatched. As the herons nest in colonies, it is often an easy matter to kill a large number by the use of rifles of small caliber. The American egret (Ardea egretta) and the snowy egret (A. candidissima) furnish the finest aigrettes, and consequently have suffered most severely; to-day the latter species is the rarest heron in the South.

Scott speaks of finding herons abundant in 1880 at a number of large rookeries on the west coast of Florida, but in 1886 the same breeding grounds were almost deserted or marked by piles of dead and decaying birds. The slaughter which had begun at least two years before was then still under way, and a price had been set on every bird of any value to the plume hunters. One man who had visited Florida for four seasons was employing from 40 to 60 gunners, to whom he furnished supplies and paid from 20 cents to $2.50 apiece for desirable skins, the average price being about 40 cents. Besides the plume birds, such as herons, ibises, and roseate spoonbills, various others—sandpipers, plovers, turnstones, least terns, boat-tailed grackles, gray king birds, and even owls—were killed for the Northern markets.* "I have heard a 'plume hunter,'" says Chapman, "boast of killing 300 herons in a rookery in one afternoon. Another proudly stated that he and his companions had killed 130,000 birds—herons, egrets, and terns—during one winter. But the destruction of these birds is an unpleasant subject. It is a blot on Florida's history."†

Unfortunately, the demands of the millinery trade are not confined to plume birds and terns or to any particular State, and the slaughter so destructive to the Florida herons is being repeated in less degree in several sections of the country in the case of other birds.

Among the few redeeming features of the feather trade should be mentioned the establishment of a new industry through the introduction of the South African ostrich (Struthio australis). The first birds, 22 in number, reached New York in December, 1882, and a few months later were placed on a farm near Anaheim, Cal. In 1899 there were several ostrich farms in southern California, and one each in Arizona, Florida, Texas, and the Hawaiian Islands. Although ostrich farming in the United States has passed through many vicissitudes and is still in its infancy, the important fact has been demonstrated that ostrich feathers can be produced in this country which are equal to the best grades imported from abroad.

GUANO.

Alexander von Humboldt, returning from his extended travels in tropical America in 1804, carried to Europe some samples of bird dung, or guano, and first called attention to the value of the extensive deposits of this substance on the Chincha Islands, off the coast of Peru. The announcement excited little interest at the time, but its importance was realized forty years later, when guano revolutionized methods in agriculture and furnished a new source of revenue for corporations, and even nations, chief among the latter being Peru, which for several years depended largely on the income from the Chincha Island deposits to pay the interest on her national debt. In the early fifties guano became the subject of diplomatic correspondence between the United States and Peru and Venezuela; but the negotiations failing to secure the desired reduction in price of Peruvian guano, deposits were sought elsewhere. Finally, Congress was induced to take action, which resulted in the taking possession by private persons under the protection of the United States of a number of small guano islands in the West Indies and in the South Pacific.

Deposits of the excrement of sea birds occur on rocky islands in various parts of the world in nearly all latitudes; but guano of commercial value is limited chiefly to the rainless regions of the tropics, usually within a few degrees of the equator. Its fertilizing value lies in the presence of nitrogen, phosphates, and a small amount of potash. Under a tropical sun the excrement dries rapidly and undergoes little change, whereas in moist climates fermentation speedily sets in, resulting in a loss of nearly all the organic matter, while the soluble alkalies and phosphates are leached out. Guano may, therefore, be divided into two main classes: (1) Nitrogenous, represented by Peruvian guano, which has undergone little change; (2) phosphatic, represented by Baker Island guano, which has lost everything of manurial value except the insoluble phosphate of lime.‡

Concerning the species of birds to which we owe these valuable deposits, comparatively little accurate information is available, chiefly because most of the islands are mere rocks or reefs, uninhabited and inaccessible, and seldom visited by ornithologists. Laysan Island, in the Hawaiian group, which has been thoroughly explored, is known to be the resort of myriads of albatrosses, man-o'-war birds, pelicans, tropic birds, gannets, terns, and petrels. Besides these species, shearwaters, gulls, and penguins occur in immense numbers on some of the islands off South America and Africa.

The importance of guano as a fertilizer was recognized by the Peruvians more than three centuries ago. Under the Incas it was held in such high esteem that the deposits on the Chincha Islands were jealously guarded, and the birds which resorted to these rocks were carefully protected. Indeed, it is said that the penalty of death was inflicted on anyone killing the birds near the deposits during the breeding season. Guano was the first of the artificial manures to be used in large quantities, and hence may be said to have brought about the modern system of intensive cultivation. The earliest experiments with it in the United States seem to have been made in December, 1824, with samples from two barrels, distributed by Hon. John S. Skinner, editor of The American Farmer.‖ Its introduction into England in 1840 was due to Lord Derby. So rapidly did it increase in favor that ten years later the imports amounted to 200,000 tons. It is estimated that this total has since grown to more than 5,000,000 tons. At the inception of the export trade in guano from the Chincha Islands, about 1840, the supply seemed inexhaustible. The deposits covered the three islands in some places to a depth of 90 or 100 feet, estimated at 12,376,100 tons, according to an official survey made by the Peruvian government in 1853. But so great was the demand for the new and powerful soil stimulant that this enormous quantity has now been practically exhausted.

The extraordinary demand caused a rapid increase in the price. By 1850 it had advanced in the United States to $50 or more per ton, and negotiations were opened with the Peruvian government in the hope of securing a reduction in the rate. Failing to attain the object in this way, American enterprise began to seek guano elsewhere, and in 1854 the deposits on the Aves Islands, in the West Indies, were taken possession of by a Boston firm. Venezuela promptly seized the islands, but after some correspondence abandoned her claim. Meantime, in September, 1855, the American Guano Company of New York was organized, with a capital of $10,000,000, for the purpose of developing the deposits on Baker and Jarvis Islands, in the South Pacific; and on August 18, 1856, Congress passed an "act to authorize protection to be given to citizens of the United States who may discover guano,"* under which any citizen of the United States was authorized to take posession of and occupy any unclaimed island, rock, or key containing guano, upon filing a notice of such claim and a bond to insure compliance with the requirements of the law. The discoverers of such islands were entitled to exclusive rights to the deposits thereon, but the guano could only be removed for the use of citizens of the United States and at a price not exceeding $8 per ton alongside the vessel, or $4 per ton on the spot. Imports were subject to the laws governing the coasting trade of the United States, and the government was relieved from the necessity of protecting or retaining possession of any island, rock, or key after the guano had been removed. Thus far claims have been filed to about seventy-five islands in the Caribbean Sea and the South Pacific.

* Proc. Cal. Acad. Sci., 2d ser., I. pp. 31-36, 1888; VI, pp. 350-358, 1896.

† Science, VII, pp. 191-205, 1886.

‡ Auk, IV, pp. 135, 213, 273, 1887.

‖ Scott, Auk, V, p. 376.

§ Birds East. N. Am., p. 82.

* Auk, IV, pp. 141 and 277.

† Birds East. N. Am., pp. 133-134.

‡ Aikman, Manures and Manuring, pp. 296-300, 1894.

‖ American Farmer, VI, pp. 316-317, 1824.

* 11 Stat. L., 119.

ELECTRICITY VERSUS GAS FOR TRAIN LIGHTING.

By ALTON D. ADAMS.

RAILWAY trains seem to be about the last important structures, where power is available, that have not generally adopted the electric light. This fact is not only to the disadvantage of the public, as to quality of service, but also to that of railway companies in the matter of operating expense. Three methods of lighting railway cars are in use, those with oil and gas, very generally, and the electric in a few cases. This condition as to the illumination of railway trains is just about that which existed in a large office, mercantile and factory building some fifteen years ago. Since that time there has been a wide and rapid change to electric light in a large part of such buildings, and the process is still going on. While the superior qualities of electric light have been factors in its application, the actual saving in the cost of operation, over other forms of illumination, has had much to do with its very general adoption in large buildings having power plants. It seems that the advantages of electric lighting that have enabled it to displace oil and gas lamps in large buildings must ultimately bring about a like result on railway trains. So far as the public is concerned, the superior quality of electric illumination is sufficient to give it a decided preference, and its greater safety and economy should appeal to railway managers.

Oil is so generally conceded to be an inferior agent for illumination, and its use in railway cars has proved so destructive to life and property, through fire at times of accident, that a comparison between gas and electric lighting should determine the most desirable method. On the score of safety from fire, gas represents a great advance over the oil lamp, since in case of accident to a car the gas does not spread flames as quickly and the supply is more easily shut off.

Electric lighting on railway trains represents a greater advance over gas, as to immunity from fire, than does gas over the oil lamp. When a railway car, lighted by gas, is overturned, it is highly probable that the gas flames will set it on fire. If an electrically lighted car is subjected to like usage, it is most probable that it will not be set on fire. To simply overturn an electrically lighted car would have no tendency to start a fire from the lamps, and even were the car broken or crushed so as to destroy the insulation on parts of the wires, the usual result would be to blow a fuse, and a fire would not probably result once in one hundred times. In those cases where the electric current is derived from machinery located at some one point in a train, a derailment would be apt to break the electrical connections between cars and thus shut off the supply.

Turning from the rather remote case of accidents to the ever-present costs of operation, the electric light can be shown to be decidedly cheaper than that from gas on railway trains. Some idea of the relative costs of the gas and electric lighting systems may be gained from the materials consumed for a given lighting effect by each. The costs of operation for electric train lighting vary somewhat according to the system used. Storage batteries are the most expensive means for train lighting, not so much on account of the losses of energy in the batteries, which amount to about 15 per cent. of the energy sent into them, as from the items of interest, depreciation, labor and repairs. If electric lighting is to be generally adopted on steam-railway trains, it seems clear that the energy must be generated by dynamos on board, as this plan is at once the simplest and cheapest. With electric current generated by dynamos on the train, conditions approach very close to those that obtain in the ordinary isolated plant.

One of the most important points to be decided for electric generating plants on railway trains is the method of driving the dynamo. Three plans for dynamo driving present themselves. Dynamos may be driven by steam from the locomotive boiler, used in a special engine; a gasoline or oil engine may be operated for the dynamo, or it may take its power from the car axle.

Two material objections exist to the supply of power for the dynamo from the locomotive boiler; one, that the available capacity of the boiler for hauling the train is thereby reduced, and the other and more serious objection that the dynamo can only be operated while the locomotive is connected with the train. That the reduction in the capacity of boiler available for train hauling is a small matter may be seen from the requirements of power for lighting purposes. Allowing 30 incandescent lamps per car, each lamp consuming 50 watts, a train of 10 coaches would consume 15 kilowatts, or 20 electrical horse power, with all lamps lighted. A good engine and dynamo, with capacity for this load, will show a combined efficiency of 80 per

cent., as to the indicated power of the engine cylinder, and a simple engine for the purpose should not consume more than 30 pounds of steam per indicated horse power hour at full load. The maximum demand for steam on the locomotive boiler should not, therefore, exceed (20 ÷ 0·80) 30 = 750 pounds per hour for electric lighting under the conditions stated. So small a per cent. of the locomotive capacity devoted to lighting purposes would not be objectionable in many cases, but might not be admissible in others. From the standpoint of lighting requirements, the necessity for locomotive connection before the dynamo can be operated is certainly objectionable, and turns attention to a system that is free from this defect.

The use of a special steam boiler on the baggage car for the purpose of electric lighting does not seem desirable, but a gasoline or oil engine may well be employed instead of a steam engine for dynamo driving. Petroleum engines, in the sizes suited for driving dynamos on railway trains, and working at from one-half to full load, may be expected to develop an indicated horse power hour on 0·8 pound of petroleum, or 0·6 pound of gasoline. Because of the explosive nature of gasoline vapor, the petroleum is perhaps more desirable for use on railway trains. Allowing the petroleum engine and its driven dynamo to have a combined mechanical and electrical efficiency of 80 per cent., one pound of petroleum is consumed for each electrical horse power hour delivered at the dynamo terminals. Each electrical horse power of 746 watts is sufficient to operate 15 50-watt incandescent lamps, so that the 300 lamps assumed to be necessary for a train of 10 coaches would require 300÷15=20 pounds of petroleum per hour of operation at full load. This includes no wiring or battery loss. A petroleum engine and dynamo in the baggage car would enable electrical lamps to be operated in any part of the train, as soon as it was made up, without regard to the presence of the locomotive.

Another method of driving dynamos on railway trains is that by which they are attached to the car axle. This plan combines the disadvantage incident to the reduced capacity of the locomotive for traction purposes with the further one that when the train stops or has its speed reduced below a certain rate the dynamo is put out of action. In order to compensate for variations in the train speed within certain limits, the dynamo must be of a special type, more expensive than the usual form. It seems doubtful whether any material advantage exists with a special dynamo driven by the car axle, over one with an independent engine, supplied with steam from the locomotive boiler. In order to render satisfactory lighting service, a storage battery is absolutely necessary on railway cars, where the dynamo is driven by the car axle, as the lamps must not go out when the train slows up or stops. With either a steam or petroleum engine to furnish power for the dynamo, a battery is only necessary if electric light must be had on the individual cars before they are connected with the baggage car. More battery capacity must obviously be had with a dynamo driven by the car axle than when an independent steam or petroleum engine is employed. In either case, however, the capacity of batteries is trifling compared with that necessary to light cars without the aid of a dynamo on the train. On the basis of the above figures, there must be 30÷0·8=37·5 pounds of steam taken from a locomotive boiler for each electrical horse power hour delivered at the dynamo terminals. Assuming a loss of 10 per cent., which is ample, in the car wiring, and in the auxiliary batteries, the delivery of one electrical horse power hour at the car lamps requires 37·5÷0·9=41·6 pounds of steam from the locomotive boiler for the dynamo engine.

If the dynamo for train lighting is driven from the car axle, it seems certain that its requirement as to increase of steam in the locomotive cylinders will be at least the amount just stated. If the locomotive boiler evaporates seven pounds of water per pound of coal burned, one electrical horse power hour, delivered at lamp terminals, requires the consumption of 41·6 ÷ 7 = 6 pounds of coal. Allowing the same loss of 10 per cent. in wiring and batteries, when a petroleum engine is used, each electrical horse power delivered to the lamps requires 1·1 pounds of petroleum in the engine. As incandescent lamps of the 50 watt or other usual size yield one-third of a candle power per watt, six pounds of coal or 1·1 pounds of petroleum furnish, through the agency of engine and dynamo, 746 ÷ 3 = 248 candle power hours. One thousand cubic feet of oil gas for car lighting can be produced from about 99 pounds of petroleum and 96 pounds of coal. This oil gas yields about 12 candle power hours per cubic foot, in open-flame burners, or 12,000 candle hours for the 1,000 cubic feet. As the petroleum consumed to produce this 1,000 cubic feet of oil gas is 90 times as much as that necessary to supply one electrical horse power hour to incandescent lamps, and the consumed coal is 16 times as great in amount, the petroleum and coal would generate 248 × 106 = 26,288 candle power hours at electric lamps. This is more than twice the amount of light derived from this fuel when employed to generate oil gas.

The plant for oil-gas production and the car equipments for its use cost probably somewhat less than do engines, dynamos, batteries and wiring for equivalent illumination, but the large saving in materials consumed, by the electric system, much more than offsets the greater first cost.—Western Electrician.

CONTEMPORARY ELECTRICAL SCIENCE.*

SPECTRUM OF RADIUM.—Demarçay has given a list of 15 spectrum lines due to "radium." C. Runge points out, however, that the accuracy of Demarçay's determinations is not very great, the error being about 0·7 of an Angström unit. Hence, Demarçay's line 4,683·0 might be anywhere between 4,682·3 and 4,683·7. But in this interval there are no less than six Fraunhofer lines, according to Rowland, and that makes the evidence for the separate identity of radium very much feebler than it was. Runge has therefore re-determined the spectrum of radio-active barium chloride with a greater dispersive power than that employed by Demarçay, and has been able to definitely locate three of Demarçay's lines. These are situated at 4,826·14, 4,682·346, and 3,814·591 respectively. The remainder were either invisible, or were found in the spectrum of barium chloride when free from radium. An economical method of spectroscopy was that of dipping a thin platinum wire into the powdered preparation and heating the wire by means of an electric current until a bead was formed, which was then made an anode in a spark-gap. But it is possible that the luminous intensity attained was not great enough to reveal some of the feebler lines described by Demarçay. In any case, the existence of at least three characteristic lines may be taken as definitely proved. They are not contained in the solar spectrum.—C. Runge, Ann. der Physik, No. 8, 1900.

ATOMIC WEIGHT OF RADIUM.—Madam Curie has made considerable progress lately toward the eventual isolation of pure radium. The latest product only contains traces of barium, and may be regarded as practically pure radium chloride. But the quantity of the salt so far available is too small to determine the atomic weight of radium from it, and the authoress has had to content herself with a determination of the atomic weight of the mixed metallic base contained in a product rich in radium. The atomic weight of pure barium is 137·5. The value for the mixed product found last November was 146, and the latest value is 174. The two last figures mark the very considerable advance made in the last half year toward the purification of the radium salt. How high the atomic weight of radium is cannot at present be even guessed at, since there is no means of determining the proportion of radium in the salt, and the spectroscope only yields very rough quantitative indications. But it is safe to say that it is very high. Radio-activity seems, in fact, to be conditioned by a high atomic weight, just as if the heavier atoms had more negative electrons to spare. It is to be hoped that, in spite of the difficulty and costliness of the work involved, the atomic weight of radium will soon be obtained from the pure chloride.—Madam Curie, Comptes Rendus, August 6, 1900.

CIRCUIT OF ELECTROLYTES.—Electrolysis without electrodes has already been satisfactorily carried out by means of liquid electrolytes moving in a magnetic field. Camichel and Swyngedauw now describe some new arrangements, one of which proves that an electrolyte can be traversed by a current without any electrolysis taking place, or at least none which involves the evolution of gas. The authors induced an alternating current in an electrolytic circuit (acidulated water of density 1·25) contained in a glass tube, under conditions in which a voltameter should have given several cubic centimeters of gas, but none was produced. In another experiment, a spiral tube of ebonite was wound about the primary coil of a transformer and inside the secondary coil, and the circuit was completed by means of a glass tube, the whole having a resistance of some 70 ohms. A constantan-iron thermo-couple indicated a rise of temperature of the order which could be expected in consideration of the experimental data. The authors also formed an electrolytic chain consisting of sulphuric acid, sodium chloride, and potash, separated presumably by porous partitions. The contact surfaces were renewed by continuous circulation. But the sensitiveness of the galvanometer employed was not sufficient to place in evidence the current probably generated.—Camichel and Swyngedauw, Comptes Rendus, August 6, 1900.

MEASUREMENT OF ELECTRIC ABSORPTION.—Rowland has described an arrangement for measuring the residual charge of a condenser, or what is now generally termed electric absorption, consisting essentially of a Wheatstone bridge, in which the fixed coils of an electrodynamometer are placed in one arm of the bridge and the hanging-coil in the cross-connection, where the galvanometer is ordinarily inserted. The adjustment of the bridge thus used depends upon the fact that there will be no deflection of the electrodynamometer if the phase-difference of the current in the fixed coils and those in the hanging-coil is 90°. L. M. Potts has tested this method and found it very satisfactory. The electric absorption always acts as a resistance in series with a capacity. This resistance is independent of the current. The temperature has a decided effect, the absorption increasing very rapidly with rising temperature. Both the capacity and the resistance depend upon the period of the current. The method is very useful for determining the capacity of a condenser showing electric absorption. The method given by Rowland for the detection of short circuits in coils proves to be an exceedingly sensitive one, and his method for the measurement of losses due to hysteresis and Foucault currents gives very good results, its chief advantage lying in the fact that only small quantities—say a few hundred grammes—of the substance are necessary.—L. M. Potts, Am. Journ. of Science, August, 1900.

ARTIFICIAL RADIO-ACTIVITY.—One method by which light may be shed upon the origin of Becquerel rays consists in endeavoring to produce them in an ordinary body by some known process. This has been accomplished by P. Villard, who succeeded in rendering ordinary bismuth radio-active by subjecting it to the action of cathode rays in a vacuum tube. The best results are obtained by employing the metal as an anode and anti-cathode combined. Those parts upon which the cathode rays impinge in the greatest intensity are the most active. Success is also attained by making the bismuth the cathode. But, then, the region whence the cathode rays emerge becomes the least active. This is not surprising, since the rays emitted by radio-active bodies probably consist of negatively charged particles. Powdered bismuth and bismuth deposited by cathode rays can also be made radio-active by this process. The radio-activity obtained is very feeble, and inferior even to that of uranium. It is, however, sufficiently intense to verify the properties of the rays photographically, and to show that they are essentially the same as those of uranium. They are also very stable, and show no decrease within a month. It remains to compare this artificial radio-activity with the induced activity discovered by the Curies. In any case much of the mystery of these rays has been now solved.—P. Villard, Bull. Soc. Franç. de Phys., 152, 1900.

ELECTROLYTIC ESTIMATION OF BISMUTH.—Hitherto it has been found impossible to obtain, by the electrolysis of bismuth salts, a sufficiently adhesive deposit to permit washing and weighing. Usually an amorphous deposit of oxide is obtained which is useless for quantitative work. A great variety of plans have been tried, but the only successful one appears to be that devised by D. Balachovsky, who states the following as the essential conditions of success: Feeble acidity of the solution; absence of chlorine, bromine, or iodine in any large quantities; feeble current; and unpolished electrodes. The best salt to operate upon is the sulphate or nitrate (but not the chloride), dissolved in nitric acid to which is added about six times its weight of urea. The maximum current is 0·06 ampere, the voltage 1·5, and the temperature 60°. The analysis takes about six hours or eight hours. Much care must be taken to prevent the current density unduly increasing, as then the deposit immediately begins to oxidize. After washing and drying the precipitate is very stable. Instead of urea, formic or ethylic aldehyde may be added to the electrolyte. The part played by these additions is not yet clear, but when aldehyde is used the temperature has to be a little higher, and the current density a little lower.—D. Balachowsky, Comptes Rendus, July 16, 1900.

MOTION THROUGH THE ETHER.—The greatest difficulty hitherto presented by the undulatory theory of light lies in the motion of ponderable bodies through infinite space occupied by an elastic solid. Lord Kelvin has approached this difficulty by a supposition which is at variance with the idea of the incompressibility of the ether, but which suggests a conceivable explanation of the difficulty, and throws some light on aberration and refraction. He supposes that each atom acts on the ether within it and around it, "according to the old-fashioned eighteenth century idea of attraction and repulsion." Also that "the distribution of positive and negative density of the atom, and the law of compressibility of the ether, is such that the average density of the ether within the atom is equal to the undisturbed density of the ether outside." He then proceeds to investigate the probable distribution of the ether within the atom, and the stream lines of the ether through the atom when the latter moves through the ether. He finds that a density of ether in the center of the atom considerably greater than 100 times the density of undisturbed ether is required to make the refractivity as great as that of oxygen. A difficulty is offered by Michelson and Morley's proof that the atmosphere carries the ether along with it. But an escape is offered through the brilliant suggestion advanced independently by Fitzgerald and Lorentz that the motion of ether through matter may slightly alter its linear dimensions.—Kelvin, Phil. Mag., August, 1900.

MAGNETIC BALANCE.—H. Du Bois has improved the magnetic balance designed in 1890 for the Physikalisch-Technische Reichsanstalt, so as to make it an instrument of precision, without reducing its practical convenience of manipulation. This task was facilitated by the proof brought by Taylor-Jones that Maxwell's law of magnetic attraction is valid over a wide range. Magnetic balancing is now superior to the ballistic method for most purposes. Superior results can only be obtained by the magnetometric study of ovoids, and these, therefore, offer a means of deciding doubtful cases. But such measurements are troublesome, and for ordinary purposes the accuracy to within 0·5 per cent. offered by the magnetic balance may be taken as sufficient. The normal sectional area of the specimen to be tested is 0·5 square centimeter. It may be fastened in two different ways, either by ordinary clamps, or, for more accurate work, between concave spherical contacts. The magnetic field is excited by two coils carrying a current of from 2 amperes to 5 amperes. The magnetic forces generated in the specimen are balanced against two running weights, moving along separate scales, one weight being twenty-five times the mass of the other. The ordinary length of specimens is 25 centimeters, but for cases of brittle metals and alloys lengths as small as 6 centimeters may be employed. The author gives the mathematical theory of the instrument in full.—H. Du Bois, Ann. der Physik, No. 6, 1900.

ELECTROSTATIC LINES OF FORCE.—In designing an instrument for plotting electric lines of force, analogous to the magnetic needle, the difficulties are encountered that the forces are small and the charge is not permanent. F. J. Rogers has, however, designed two kinds of "electrostatic needles" which answer very well. The first consists of an aluminium needle bearing at its ends two gilt pithballs. The needle is perforated in the center and mounted on a horizontal pin stuck into an ebonite rod. With this simple contrivance it can be shown to the student that the lines of force are normal to the surface of a charged conductor and not normal to the surface of an ebonite rod and that in the case of two oppositely charged conductors placed near each other the lines of force issue from one conductor, curve over, and end on the other. The second form of needle is even more useful. It consists of a little ebonite rod in place of an aluminium needle, and the pithballs are charged positively and negatively respectively. Thus we have a complete analogue of the magnetic needle. If the neutralizing rod of a Voss machine is removed while the machine is running, the inductors change the sign of their charge every few seconds. This change of sign is promptly indicated by the electrostatic needle described.—F. J. Rogers, Phys. Review, July, 1900.

CONTINUOUSLY ADJUSTABLE CONDENSER.—L. J. Briggs has designed an adjustable condenser on a modern plan. It is of the mica type, but the usual tinfoil is replaced by slightly curved elastic brass sheets. The effect of this is that the condenser tends to expand, and has to be kept pressed down by a screw press. The process of screwing down and thus flattening the sheets is to increase the capacity of the condenser, and when they are quite flat the capacity in one such instrument is four times the original capacity. The curvature given to the sheet brass by the manufacturer in rolling it for shipment is found to answer very well. The range of capacity may be greatly increased by dividing the condenser into three or four sections, so arranged as to permit their being thrown in multiple by a suitable switch. By dividing the condenser into three sections, the first of which contains three-fourths of the condenser sheets, the second, three-

* Compiled by E. E. Fournier d'Albe in The Electrician.

fourths of the remainder, and the third section the remainder of the sheets, the range of capacity can be increased sixteen times, or the minimum capacity obtainable will be one sixty-fourth of the maximum. The adjustment will, moreover, be perfectly continuous throughout this range. On account of the double dielectric used (mica and air or oil) the change of capacity is most rapid when the plates are nearly flat.—L. J. Briggs, Phys. Review, July, 1900.

MOVABLE RAMPS AT THE PARIS EXPOSITION.

Along with the movable platform and the electric railways of all kinds, the Exposition of 1900 has shown us another method of conveyance, which also is electric and not without interest.

With the object in view of forcing the public to visit the galleries of the first story, which are too often deserted in expositions, the Commissary-General in 1898 opened a competition for the production of movable ramps designed to supply the place of stairways, and gave the construction and exploitation of the same to three manufacturers.

MM. Piat & Sons, whose Hallé system has been in operation at the great stores of the Louvre for several years, constructed eighteen ramps, seven at the Invalides, ten at the Champ de Mars and one at the Exposition of Madagascar.

The Société Française de Constructions Mecaniques (Anciens Etablissements Cails) constructed five ramps of the Reno system, which is in use in New York and Brooklyn—one in the extreme corner of the old gallery of machines and four in the Palace of Letters, Sciences and Arts at the Champ de Mars.

M. Jules le Blanc devised an entirely new system, five specimens of which are shown; one in the Swiss

Fig. 1.—GENERAL VIEW OF A MOVABLE RAMP.

section of the old gallery of machines, and the others in the Palace of Civil Engineering and Conveyances.

These twenty-eight ramps ascend to a vertical height of from 23 to 26 feet according to the site; their oblique lengths are respectively 69 and 72 feet. Moreover, in the American section of the Palace of Thread, Fabrics and Clothing, the Otis Company exhibits a new apparatus that it calls the "Escalator" and that is based upon a principle entirely different from that of the other systems.

Finally, let us state that MM. Cance and Grandemange have installed two ramps for giving access to the movable platform at the Champ de Mars, so that the total number of movable ramps is 31.

The following is the principle of these apparatus: Let us suppose a large steam engine belt 24 inches in width stretched between two pulleys and running slowly, according to a proper inclination—say about 4 inches to the foot. If we place our foot upon the belt above the lower drum, we shall be carried above the upper drum without having had to make any motion.

In fact, it is necessary to arrange the whole upon an inclined metallic girder, which supports the axles and the stationary parts of the system. It requires two floors, one below for the entrance of the passengers, and one above for taking them to the upper generatrices of the two drums. In order to prevent an undue tension, the belt has to be supported by rollers. For the sake of safety, it has to be provided with two guards that move with the same speed as the belt. Stretchers are arranged for the regulation of the belt, which is one inch in thickness.

Such is the very simple principle of the Hallé-Piat system shown in Fig. 1. The guards are formed of a band of India-rubber of special form covered with cloth. They disappear at the upper part in boxes provided with flanges forming hand guards. This arrangement, with a few variations, is found in all the systems.

A dynamo and a transmission drive the upper drum and guards at a mean speed of 20 inches per second.

The Reno system comprises an endless web formed of bars of wood which are provided with rollers that are formed of a material called "hemacite" and that run upon rails. The returning half is suspended from

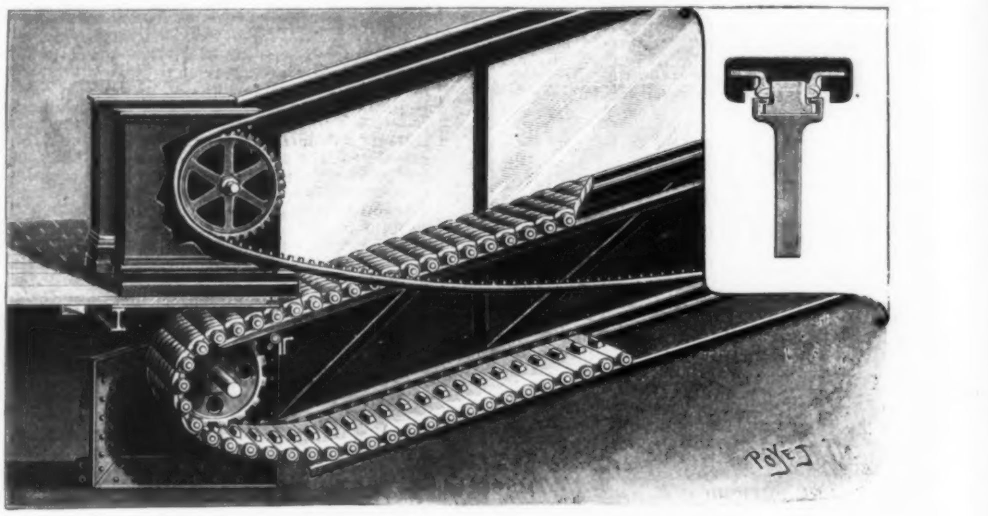


Fig 2.—THE LOWER PART OF THE RENO-CAIL RAMP.

a rail lodged in the lower chord of the principal girder. This arrangement of chains with detachable links permits of doing away with stretchers.

The jointed web is actuated by a chain of which each link corresponds to one of the bars of wood. This passes at the upper part over an indented wheel actuated by the electric motor with the interposition of a shaft with a ratchet to prevent any return in an opposite direction.

The jointed bars are provided with rubber projections for the purpose of giving the feet a firm hold. These projections, which are arranged in longitudinal bands, make their exit at the lower part and disappear at the upper between the teeth of metallic combs designed to take up and set down the passengers without jerks. The guards consist also of endless chains covered with rubber and cloth. Each link of the chain slides in a groove that prevents any lateral displacement.

The Le Blanc system likewise consists of bars forming an endless web. These rest upon two parallel endless chains which are actuated by two large toothed wheels placed at the upper part and driven by a dynamo with a transmission through an endless screw and wooden cogwheels that produce a minimum of noise. The endless web is supported by small rollers spaced about 14 inches apart and is kept taut at the lower part by powerful springs provided with regulating screws. The guards likewise are formed of endless chains sliding in grooves and covered with sections of jointed wood having a profile like the railings of stairways (Fig. 3).

As for the Otis Escalator, that differs in toto from the movable ramps. It consists of a true stairway which moves in a lump. The steps are sufficiently wide for two or three persons. It suffices to mount the first step in order to be carried along at a speed of about five feet a second.—La Nature.

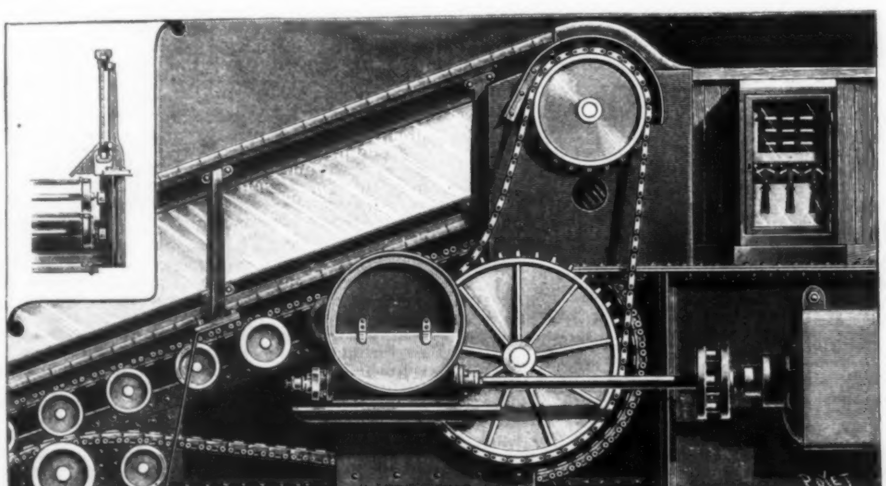


Fig. 3.—THE UPPER PART OF THE LE BLANC RAMP.

FERRO-TITANIUM AT NIAGARA FALLS.

Experiments which Auguste J. Rossi has been conducting in what is known as the old Porter house on the lands of the Niagara Falls Power Company give good promise of resulting in the establishment of another great manufacturing industry at Niagara Falls, says The Electrical World. Already the Ferro-Titanium Company has been incorporated with a capital of $100,000 to carry on the process of manufacture covered by patents which have been granted to Mr. Rossi.

In the past it has been the understanding of the iron trade that ore containing titanium was unfit for use, but by Mr. Rossi's methods this class of ore is brought into service and from it the best of steel is manufactured. The value of this to the iron world can best be appreciated when it is known that the American continent contains immense deposits of this class of ore, the great majority of which is near the surface, is easily mined, and lies close to the consuming markets. In other words, one of Mr. Rossi's discoveries, it is expected, will bring into use, just at a time when people have begun to predict an iron famine, a vast amount of ore which can be treated so as to make it available for all purposes for which iron is used.

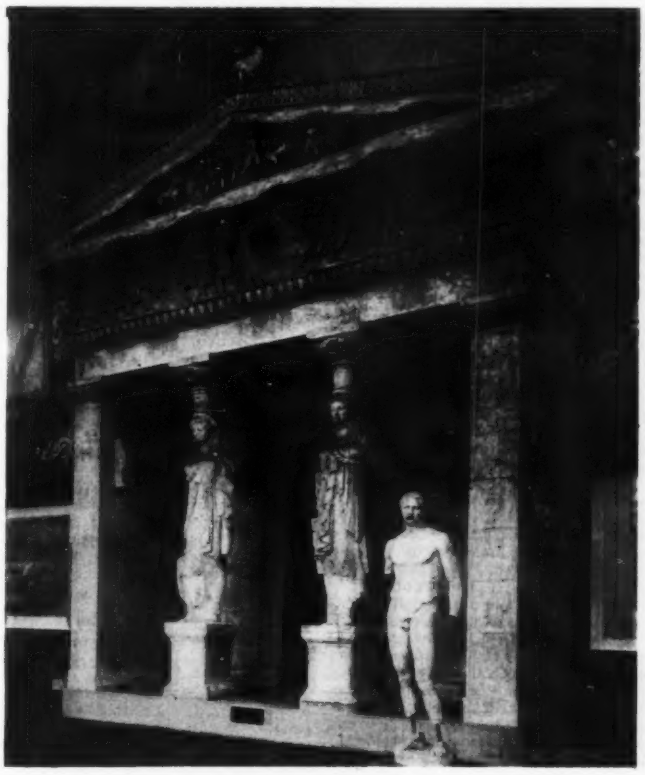
It is a well-known fact that during recent years several ferro metals have presented themselves for the recognition of the steel manufacturers of the world. All of them have brought about results valuable in their way, but still the cost of these ferro metals has been and is quite high. Mr. Rossi has directed his efforts to the production of a ferro metal which would combine all the elements of hardening steel with cheapness, and he has produced what is called ferro-titanium. It is given out that this is not the first time it has been made; that it has been made in Germany, and that the Krupps owe much of their success to its use. While this may be, during the time the experimental station has been in operation at Niagara Falls enough of it has been manufactured to make it possible to afford prominent steel makers throughout the country an opportunity of testing its value, with the result that ferro-titanium is given a position which appears to place it as the ideal help steel makers have been seeking. The qualities that it imparts to the steel in which it is used are pronounced most desirable. Reliable data as to the exact results are not yet given out, but experiments in progress are expected to develop much information of this kind. Usually, if a product is improved by the addition of any article, the consumer is willing to pay the customary advanced cost, but where an article is improved and cheapened also, as ferro-titanium promises to do with steel, the consumption must be greatly extended and the work in which it is used benefited.

The marvelous prosperity which the iron industry on this continent has enjoyed, and continues to enjoy, has commanded general attention, until it is now conceded that steel is a great pulse of the country's industrial condition. Many new steel plants are projected, and new sections of the country are capturing them. This is notable of the big works now in course of construction at Stony Point, on Lake Erie, near

Buffalo, and others are mentioned for the Buffalo locality, the sites being between the Falls and Buffalo. One of the chief capitalists interested in the Stony Point plant is J. J. Albright, of Buffalo, who also is interested in the Ferro-Titanium Company referred to. Other men of prominence mentioned are Gen. Field, Edmund Hayes, of Buffalo; James NacNaughton, of New York, and C. S. Maurice, of Athens, Pa. Mr. NacNaughton is president of the Ferro-Titanium Company. The product of the present temporary Niagara plant is about 500 pounds of ferro-titanium a day.

THE DELPHI COLLECTION AT PARIS.

ON the second floor of the Liberal Arts Palace is an archæological collection of considerable interest. It represents the work which is now being carried on at Delphi, where a series of excavations have been made by the French School of Athens, of which M. Homolle is director. This institution has been established by the government, under the direction of the Minister of Fine Arts, for the purpose of carrying on archæological work in Greece. Its headquarters are located at Athens, from whence different expeditions are sent out. The recent excavations at Delphi have laid bare the greater portion of the Sanctuary of Apollo, and a good idea may be formed of its arrangement. Four large water-color drawings show the site in its present condition, and the restoration according to the data obtained. The site is inclosed by a wall, and contains the Temple of Apollo, which occupies the central position. Grouped around it are a series of smaller structures, erected by the different nations to contain the offerings presented by them; here are represented the Athenians, Thebans, the kings of Argos, etc. According to the restoration, these buildings present a splendid architectural ensemble, many of them being ornamented with statues and gold tripods; back of the main temple is a theater of hemispherical shape. The actual view of the site, however, shows that most of the buildings have been destroyed; the portions that remain, however, show the magnificence of this celebrated site. One of the illustrations shows the façade of the edifice erected by the Athenians. It was undoubtedly erected at an early date, as is shown by the archaic form of the caryatides and the figures above in high relief; the figures in low relief, however, recall those of the Parthenon, and are of fine execution. Those on the right represent battle scenes, while on the left are a number of personages seated. Originally, a frieze ran around the wall in the interior of the portico; fragments of this frieze still remain; it represents for the most part battle scenes. At the back is a large square doorway, which gives access to the building.



FAÇADE OF A TEMPLE FROM DELPHI.

The second illustration shows a reproduction of two of the columns which were erected near the main temple. In the foreground is the upper part of an acanthus column surmounted by three caryatides. The restoration of this column shows that it reached a considerable height. It is formed of a triangular fluting which alternated with an acanthus leaf design. The caryatids supported a gold tripod at the top of the column. In the background may be seen the column and sphinx of the Naxians. It carried a continuous circular fluting of primitive character, and belongs to an earlier epoch. At the top is an Ionic scroll, supporting a sphinx of archaic form, with wings curved upward above the back. According to the restoration, the wings and head-dress of the sphinx were colored in red and yellow, while the capital had a polychrome decoration.

A number of statues have been found upon the site, and many of these are represented in plaster. On each side of the portico is an archaic statue of Apollo. A statue of a much later period is shown in front of the portico; it is in a fairly good state of preservation. In front is a bronze statue of a victor in the chariot race; the eyes of this statue are in vitreous material, which give it a lifelike expression. The chariot rider, which may be distinguished between the two columns in the second illustration, is draped in a long tunic, with his hand outstretched in the act of holding the reins.

In the foreground of the second illustration is shown a number of objects illustrating the expedition of M. de Sarzec in Chaldæa. The beginning of the excavations made in that region dates from 1870, and since that time a number of objects of great interest have been found, most of these dating from very early periods. The greater part of these objects have been placed in the Louvre. The case in the rear contains fragments of a stele which dates from the fortieth century B.C., in the reign of Eannadou, grandson of Our-Nina. It has been partially restored under the direction of M. Leon Huzey. On one side are represented various battle scenes, and on the other a personage holding the royal insignia. The front case contains a number of objects, all of very early periods; most of these are shown in reproduction. In the upper part, the large onyx plaque in the center dates from the epoch of Mammaghani, about 3000 B.C., executed after the original in the Museum of Constantinople. To the right is a mortar in green diorite bearing the name of Enannatouma, grandson of Our-Nina, and his fourth successor. To the left is a circular altar with a relief decoration around the edge; it is of a period anterior to Our-Nina. In the center is the reproduction of a Chaldean statue presented by Hamdy Bey, director of the Museum of Constantinople, and on one side of it is a plaque in madreporic stone decorated with lions' heads. On the other is an onyx plaque of the epoch of Our-Baou. Below are two onyx bowls dating from the fortieth century B.C., and at the end of the case is a lion's head in alabaster of the same epoch. Below it may be seen a brick of the same period, and another on the left bearing the emblem of the city of Sirpoula, an eagle with lion's head.

ACETYLENE AND ALCOHOL VERSUS GASOLINE AS FUELS.

By ISAIAH L. ROBERTS.

THE choice of any fuel for use in the arts of man depends on the purpose for which it is to be used, regardless of its first cost or comparative thermic value per unit of weight. For instance, coal or coke is generally used as a fuel for generating heat to melt iron, but it has been proved that powdered aluminium can be more advantageously used to melt iron in a small crucible in a few seconds just when and where it is needed, notwithstanding it costs per heat unit more than one hundred times the price of coke. Magnesium is one of the most expensive of all fuels, but it will make a quick fire and light by which a photograph or signal may be produced cheaper than with commercial oil. Therefore, in choosing a fuel we must take into consideration all the conditions under which it is to be used for accomplishing the object sought.

This article will be confined to a comparison of the value of petroleum, acetylene and alcohol as fuels for use in the propulsion of self-moving vehicles by explosion in the cylinders of their engines, and not as a fuel to generate steam. However, from the data here given the reader will see that where steam is to be generated the choice of one of the three above mentioned must rest on the one which will yield the greatest number of heat units for a unit of cost of a unit of weight, as well with a steam generator as with an explosive motor, where all are of equal convenience.

The amount of heat generated by the combustion of any substance in oxygen has been accurately ascertained by many independent investigators by actual experiment and test. Among these may be mentioned Andrews, Favre and Silberman, Julius Thompson and Berthelot and others; hence there is no longer any question about the facts here set forth.

All the value of the above fuels depends solely on the amount of hydrogen and carbon they contain, and, as above stated, each one of these substances yields a known amount of heat per unit of weight; therefore, if we take as a unit a gramme, kilogramme or pound, we can state just how many heat units will be evolved by the combustion of that unit in air, which is only oxygen diluted with nitrogen in the proportion of about 23 parts of oxygen to 77 of nitrogen, and this is the uniform proportion the world over, regardless of altitude. While the nitrogen is a neutral substance and does not enter into chemical combination with any of the products of combustion, it nevertheless serves a very important part in the propulsion of the piston in the cylinder of an explosive engine. It absorbs the heat at the moment of combustion and yields it up in work by expanding as the piston moves. It is not necessary to go into further details on this point in this article, as the reader will find this subject fully worked out in the great works of Maxwell, Carnot, and others.

Having before us the wonderful work of those patient and beneficent men above mentioned, we can now determine beforehand what the value of a fuel is by simply knowing its chemical composition.

In the examination of the three substances, viz., petroleum, acetylene and alcohol, we will proceed in the order named. On examination of the chemical composition of the petroleum series, we find it is made up by the addition to each other of the hydrocarbon radical CH_2 to the foundation one called methane, CH_4. This addition was performed by nature in the interior of the earth in some past age in a manner not yet clearly understood. Most of the groups of this hydrocarbon have been studied and named chemically and somewhat roughly commercially, but we cannot go extensively into the composition of all of them here. It is sufficient to say that the first three are gases which have the formulas CH_4 methane, C_2H_6 ethane and C_3H_8 propane in various and ever varying proportions, and compose what is known as "natural gas." The next three groups, when mixed, as they always are in the distillation of crude petroleum, are called in the trade "gasoline." These have the formulas C_4H_{10} butane, C_5H_{12} pentane, C_6H_{14} hexane.

GENERAL VIEW OF DELPHI EXHIBIT AT THE PARIS EXPOSITION.

Butane boils at 1° C., pentane 38 and hexane 70. The next two or three are called in the trade "kerosene."

The operator of gasoline motors finds in the case of automobiles, when using only a cool carbureter, that toward the last of the run there remains an oil that will not volatilize sufficiently to enrich the air in the cylinder to that degree necessary for an explosion. The reason of this is that the gasoline of commerce, unless especially distilled for that purpose, contains a considerable per cent. of heptane, $C_7 H_{16}$, and some octane, $C_8 H_{18}$, or in other words, kerosene. Still higher comes the heavy oils, and finally paraffine wax, and even tar, all of which have names, and are built up by the continually advancing addition of CH_2.

Acetylene, on the other hand, is also a true hydrocarbon, but has the uniform formula of $C_2 H_2$, while the alcohols are oxygen derivatives of the hydrocarbons mentioned above. Therefore, we have from methane, CH_4 methyl alcohol, $CH_4 O$ or wood alcohol, and from ethane, $C_2 H_6$ ethyl alcohol, $C_2 H_6 O$, or common spirits of wine, and chemically we can produce propyl alcohol, $C_3 H_8 O$, from propane, $C_3 H_8$, and so on with the rest of these hydrocarbons; but they are too expensive to be used as fuels when compared to ethyl and methyl alcohols. It will be seen from the foregoing that we have just two elements for fuel out of all this array of formulæ and nomenclature, viz., hydrogen symbol H and carbon symbol C. Now, the exact amount of heat produced by the combustion of each of these per unit of weight as aforesaid is well known, so that it does not matter how these elements cling about each other in their molecular formation, nor what name these different groupings have, or how differently they taste or smell; when oxygen comes courting they all break up their weak union with each other and rush to form a new union with it, which will be more stable, and in so doing each gramme or kilogramme of hydrogen yields 34·462 heat units, or in other words, will raise the temperature of 34·462 grammes or kilogrammes of water 1° C.; or, if one gramme be burned, it will raise the temperature of 34·462 grammes of water 1° C.; hence we say that one unit of hydrogen burned has 34·462 heat units, and so on with any substance whatever, according to the strength of its affinity for oxygen. Carbon yields on burning in oxygen, when forming CO_2, about 8,000 heat units.

Now, from these known data it is easy to figure out the heat units that are contained in a pound or kilogramme of CH_2, which is the general formula for petroleum compounds, commonly called in the trade rigoline, benzine, gasoline, kerosene, etc.

I prefer to use the kilogramme and gramme in the calculations here, because they are the standard units now used all over the world in chemical calculations. The kilogramme is about 2·2 pounds and a gramme is one-thousandth part of a kilogramme.

Now, if we take a kilogramme of gasoline, which will be nearest represented by hexane, $C_6 H_{14}$, although the other two are present, it will be seen that it does not materially alter the calculation if we took pentane, $C_5 H_{12}$; but as the former predominates in ordinary gasoline, it will be the basis of our calculations.

Now as the atomic weight of carbon is about 12 and hydrogen about 1, we have 72 grammes of the former and 14 of the latter in 86 grammes of hexane. Therefore, we have 837·2088 + grammes of carbon and 162·7906 + grammes of hydrogen in 1,000 grammes, or 1 kilogramme. If we multiply the carbon grammes by 8,000, the heat units of carbon, and the hydrogen by 34·462, the heat units of hydrogen, we have 6,697,670·4 + grammes heat units for the former and 5,610,413·6 + for the latter, or 12,308,083 + total for both per kilogramme.

The formula of acetylene being $C_2 H_2$, there is in one kilogramme of that gas 923·04 + grammes of carbon, which has 7,384,320 + heat units, and 76·92 + grammes of hydrogen, which has 2,650,817 +, or a total of 10,035,137 + heat units.

The formula of wood alcohol, $CH_4 O$, will be used for our calculation, as ethyl alcohol, or spirit of wine, is so taxed by the government that it cannot be used as a fuel, and if it could be it would not have any more heat units than methyl, as will be seen by figuring from its formula, $C_2 H_6 O$.

In calculating the heat units of alcohol, we must begin by throwing out of the formula the $H_2 O$, water, because alcohol is really only the radical, CH_2, combined with a molecule of water by fermentation in nature of synthesis in the arts. Therefore, we must add, as above, this water in order to get the total weight, and then deduct it. Thus, $CH_2 + H_2 O$, or carbon 12, hydrogen 2; then hydrogen again in the water, 2, and oxygen 16. This gives us 32 as the divisor of 1,000 grammes and shows more than half of our alcohol is water, as C and H_2 equal 14 parts, while the H_2 added to 16 of oxygen equal 18 parts. Therefore, the available carbon in a kilogramme of alcohol is 374·616 grammes, which, multiplied by 8,000, gives us 2,996,928 +. The available hydrogen is 62·436 × 34·462 = 2,151,669·432 +, or total for both of 5,148,597·432 +.

This, however, is too favorable a showing for alcohol, even if pure, which it never is in commerce. It always contains a percentage of water; besides, we must deduct the heat units that are lost in the evaporation of the 561·824 + grammes of water; but in this article we cannot go into the question of latent heat, which is, however, nearly the same for all of the hydrocarbons, but the water of combination in the alcohol is a distinct loss over that of mere combustion, and is considerable.

In summing up the situation we must take into consideration the cost of a kilogramme of the substances mentioned, which are of course subject to fluctuations in the market. Gasoline can be purchased by the small consumer at about 5 cents per kilogramme, while acetylene must be generated from carbide of calcium, which will probably cost 10 cents per kilogramme to the small consumer, in cans, and as the average carbide will not run over 10 cubic feet of acetylene to the kilogramme, and as roughly about 30 cubic feet weigh a kilogramme, we need 3 kilogrammes of carbide, which will cost about 30 cents. Alcohol can be obtained at about 40 cents per kilogramme. Having all this data at hand, we can make the comparison of cost as fuel of the three substances named above:

Gasoline, per kilogramme, 5 cents; heat units, 12,308,083 +.

Acetylene, per kilogramme, 30 cents; heat units, 10,035,137 +.

Alcohol, per kilogramme, 40 cents; heat units, 5,148,597 +.

It would seem from the above figures that we must look to petroleum for some time to come for a source of heat if the price is to determine our choice. — The Horseless Age.

[Concluded from SUPPLEMENT, No. 1296, page 20776.]

CHEMICAL AND TECHNICAL EDUCATION IN THE UNITED STATES.*

By Prof. C. F. CHANDLER, Ph.D., M.D., LL.D., D.Sc., Oxon.

ALCOHOL.

THE manufacture of alcohol and alcoholic beverages has reached enormous proportions in the United States on account of the cheapness of our cereals. Seventy-five per cent. of the grain employed in the manufacture of distilled spirits is corn (maize). Next in order comes rye, and then malt. Considerable molasses is also employed in the manufacture of rum. There are several ways of managing the whisky production from corn. There is first what we call "sweet mash whisky." After putting the boiling water on the corn meal, adding the malt, and cooling to the proper temperature, there is added a very clean fresh yeast, that has never been used before for making whisky. This is very vigorous in its action and produces the largest amount of alcohol with the least amount of flavor.

If, on the other hand, old yeast from previous fermentation, which has become soured, is employed, while it is not as vigorous in its action and does not produce as much alcohol, it develops a much higher flavor, and the product is called a "sour mash whisky."

There is still a third method of procedure, which is called the "slop process." The slops which are left in the still after distilling off the whisky are used boiling hot for mashing the next batch of corn meal. This process combines the qualities of the other two and produces a large percentage of alcohol with a high flavor.

After the meal is properly mashed, the ground malt is added for the purpose of converting the starch into fermentable sugars. After the fermentation has proceeded 48 to 72 hours, the beer is put into the still. There are two sets of stills employed in the corn or Bourbon whisky manufacture. First, the beer stills which produce from the beer, containing from 5 to 8 per cent. alcohol, the "singlings," which contain from 15 to 20 per cent. of alcohol; secondly, the "doubler," which raises the "singlings" to proof or higher. Proof spirits with us means 50 per cent. of alcohol by volume, or 50 gallons of absolute alcohol in 100 gallons of proof spirit; and it is a curious fact that it requires 53·72 gallons of water to make with the 50 gallons of alcohol 100 gallons of proof spirit. The usual proportions of grain for the Bourbon whisky is 80 per cent. corn, 10 per cent. rye, and 10 per cent. malt.

Special methods are resorted to for the manufacture of expensive, high-flavored whiskys from rye and rum from molasses. A large proportion of the corn whisky is subsequently rectified and purified by distillation with alkali, filtration through charcoal, and the use of column stills, and when completely freed from fusel oil and concentrated up to 94 or 95 per cent. it is known as "French or Cologne spirits."

DIFFERENT KINDS OF SPIRITS PRODUCED DURING YEARS ENDING JUNE 30, 1898 AND 1899

	1898.	1899.
	Proof Gallons.	Proof Gallons.
Bourbon whiskey	13,439,458·9	17,256,330·8
Rye whiskey	8,818,240·0	10,792,825·1
Alcohol	11,672,794·8	11,974,354·0
Rum	1,340,546·5	1,494,379·3
Gin	1,267,579·5	1,266,823·4
High wines	174,124·4	420,832·6
Pure, neutral, or Cologne spirits	20,613,205·3	25,876,228·1
Miscellaneous	23,436,264·0	27,984,781·4
Totals	80,762,213·4	97,066,554·7

MATERIALS USED FOR THE PRODUCTION OF DISTILLED SPIRITS. YEAR ENDING JUNE 30, 1899.

——	Bushels.	Gallons.
Malt	2,471,417	..
Wheat	19,182	..
Barley	1,518	..
Rye	3,383,907	..
Corn (maize)	15,682,809	..
Oats	14,805	..
Mill feed	1,350	..
Molasses	..	2,920,000
Other materials	5,420	..
Total	21,580,468	2,920,000

DIFFERENT KINDS OF FRUIT BRANDY PRODUCED DURING THE YEAR ENDING JUNE 30, 1899.

	Proof Galls.
Apple	210,188
Peach	40,781
Grape	2,843,718
Pear	731
Berry	112
Prune	2,239
Total	3,097,769

According to the internal revenue reports, the average yield of a bushel of corn is 4·46 gallons of proof spirits, the average yield of a gallon of molasses is 0·841 gallon of proof spirit. It is said that it actually costs only ten cents to manufacture a gallon of 94 per cent. alcohol. The internal revenue tax is $1.10 per gallon of proof spirit. Up to the present time no system has been adopted in the United States for denaturalizing alcohol in order to relieve the industrial arts and the manufacturers of pharmaceutical chemicals of the burden of this tax. Many attempts have been made to secure adequate legislation on this subject, but thus far in vain. As a consequence large industries have grown up for the purpose of supplying solvents to take the place of alcohol, solvents which, though much more expensive to manufacture, are not burdened by the internal revenue taxes and are consequently cheaper to use. There were in the United States in 1899, 1,286 grain distilleries and 2,621 fruit distilleries, chiefly grape and apple, the latter being generally very small.

The most important substitute for grain alcohol in the arts is wood or methyl alcohol. Of this there were produced in 1899 about 4,000,000 gallons. Associated with this, of course, is a large industry which results in the production of pyroligneous acid, acetate of lime and refined acetic acid. A considerable industry has also grown up in the manufacture from acetate of lime of acetone, which is used as a solvent and also as a substitute for alcohol in the manufacture of chloroform. This substitution of acetone for alcohol has resulted in a great reduction in the price of chloroform. The manufacture is extremely simple and the yield is over 160 per cent.

Frequent fatal accidents have occurred from the drinking of wood alcohol by mistake for grain alcohol.

There are about 90 factories devoted to the manufacture of acetate of lime, with an aggregate product of 35,000 to 40,000 tons per annum. As there is little sale for pyroligneous acid, it is all worked up into wood alcohol and acetate of lime.

The fermented liquors manufactured during the year ending June 30, 1899, amounted to 36,581,114 barrels, or 1,134,014,534 gallons, mostly beer.

FATTY ACIDS AND GLYCERIN.

Another chemical process which has proved remarkably successful was invented by Tilghmann, and consists in hydrolyzing the fats for the production of fatty acids and glycerin by superheated water. It has taken the place of all the other processes for accomplishing the same result. It is too well known to require description.

COTTON SEED OIL.

Cotton seed oil is one of our great southern products. There are probably 500 cotton seed oil mills in the United States, with a capacity of from 300 to 500 tons of seed per day. The amount of seed crushed is between one and a half and two million tons per annum. It yields from 38 to 43 gallons of oil per ton of 2,000 pounds of seed; that is, seed after the lint has been removed by the gins. The seed is first passed through the linting gins, by which about 80 pounds of lint per ton of seed is saved. The seeds are next hulled, the hulls being used as fuel under the boilers. The meal having been extracted from the hulls is then subjected to the cooking process and subsequently pressed. The residue remains in square, flat cakes, hard, brown and dry, which are ground into cotton seed meal, a valuable food for stock, and sometimes used as a fertilizer. About 800 pounds of cake are obtained per ton of seed. It contains about 10 per cent. of oil and yields from 7 to 9 per cent. ammonia by the decomposition of the proteids which it contains.

This cotton seed oil is a perfectly wholesome article of food, and a great deal of it finds its way, I think, to the table all over the world as salad oil.

ARTIFICIAL BUTTER.

The oleomargarine industry continues to flourish in the United States, notwithstanding the ban under which it is placed by the state and federal laws, which discriminate against it. It is not so much the farmers who protest against artificial butter, as it is the politicians who seek to appear as the farmers' friends. It having been determined by most careful studies in all parts of the world that the artificial oleomargarine butter is a perfectly wholesome article of food, the legislation against it has always seemed to me to be entirely unwarranted, and reminds me of the legislation in the days of Queen Elizabeth against the use of the indigo from Bengal and logwood from Central America. Under our laws manufacturers of oleomargarine must not only secure a license from the national government, but must pay a heavy tax upon every pound of product. Recent attempts to make the laws still more stringent have not proved successful.

Under a resolution of the House of Representatives, the Commissioner of Internal Revenue was compelled to disclose the nature and quantities of the ingredients employed in the production of oleomargarine butter during the past year. The report was as follows:

OLEOMARGARINE.

Statement showing the Quantities and Kinds of Ingredients used in the Production of Oleomargarine in the United States for the Fiscal Year ended June 20th, 1899; also the Percentage each Ingredient bears to the whole Quantity:—

Materials.	Pounds.	Percentage.
Neutral lard	31,297,251	34·27
Oleo oil	24,491,769	26·82
Cottonseed oil	4,357,514	4·77
Sesame	486,310	0·53
Colouring matter	148,970	0·16
Sugar	110,164	0·12
Glycerin	8,983	0·01
Stearine	5,890	0·007
Glucose	2,550	0·003
Milk	14,200,576	15·55
Salt	6,772,670	7·42
Butter oil	4,342,904	4·76
Butter	1,568,319	1·72
Cream	3,527,410	3·86
Total	91,322,260	100·00

LEATHER.

Owing to the abundance of oak and hemlock bark and the extensive cattle raising in the United States, the leather industry has made great progress, and it is so well established that hides are imported from all over the world to supply the tanneries. The new bichromate of potash process of tanning goat skins, invented by Schultz, has been generally adopted, and has practically revolutionized the manufacture of the finer kinds of leather.

* Read at the nineteenth annual general meeting of the Society in London, in the theater of the Royal Institution, Albemarle Street, on Wednesday, July 18, 1900, Prof. C. F. Chandler, President of the Society, in the chair.

TEXTILE INDUSTRIES.

It is impossible in the short time at my disposal to give anything like a comprehensive view of all the industries which involve the application of chemistry, and which require the services of a trained chemist to a greater or less degree.

Among those which I shall have to pass over are, for example, the textile industries, including the manufacture of ginghams and calicoes, woolen goods and silks. The magnitude of the latter industry can be inferred from the fact that there were imported into the United States during the year 1899, 77,414 bales of raw silk, valued at $42,399,604. In fact, the United States has now become the greatest of all silk consumers in the world except, perhaps, China or Japan, the correct statistics of whose consumption are not available. There were 865 silk factories in the United States in the year 1899, employing 93,600 workpeople.

PAPER.

The ever-increasing demand for paper, and the abundant supply of wood in the United States, has led to an enormous expansion of the wood-pulp industry. There are over two hundred pulp mills using the mechanical process, that is, simply grinding the wood in a stream of water. This is the cheapest method for making the pulp, but the pulp is poor in quality. There are about fifty mills manufacturing the pulp with the aid of bisulphite of lime. The wood in chips is subjected to the bisulphite solution under pressure in vertical cylinders, sometimes of enormous dimensions. The largest I have seen were 15 feet in diameter and 49½ feet in height. The pressure reaches finally about 85 pounds to the square inch, and the time occupied in converting the chips into pulp is about twelve hours. It is estimated that there are 1,500 tons of bisulphite pulp produced daily in the United States. The mills average from 25 to 30 tons each.

It is estimated that one cord of spruce timber will produce one ton of ground pulp, or one-half of a ton of sulphite pulp. For newspaper use, 80 per cent. of ground pulp and 20 per cent. of sulphite pulp are combined.

Our hills and valleys are being so rapidly denuded of their forests, and our watercourses in consequence indulge in such devastating freshets in the spring and tantalizing droughts in the summer, that we are now moving to establish schools of forestry in different parts of the country, and setting aside large areas of woodland as State and national forest preserves, in order to protect the country from the terrible evils that result from cutting down the forests.

INDIA RUBBER.

One of the great chemical industries of the United States is the manufacture of India rubber goods, an industry which we regard as peculiarly American. Little use was made of this substance in the arts until Charles Goodyear, of Massachusetts, invented soft vulcanized rubber. The defects of raw rubber were numerous. It became rigid and inflexible in cold weather; it softened and decomposed in hot weather; it was very soluble in contact with fats and oils; it was very adhesive when two surfaces were brought together; it lost its elasticity by continued tension or constant use. All these difficulties were obviated by Mr. Goodyear's invention, which consisted in incorporating with it a small percentage of sulphur, with or without the addition of diluents such as carbonate of lead, oxide of zinc, etc. This mixture was kneaded upon hot steel rolls, and made up into various forms, either by itself or spread upon cloth, and when the final shape had been given to the material, the articles were placed in enormous horizontal cylinders and exposed to steam heat under pressure at a temperature not exceeding 275° Fahrenheit. The result of this was a new material, permanently elastic, pliable, durable, insoluble, unchangeable by climate or moderate heat; inadhesive; and impermeable to air, gases and liquids. This new material was adaptable to so many purposes that an enormous industry sprang up in its manufacture, and great demands were made upon tropical forests for a supply of the raw material. New applications are constantly appearing. It was originally employed chiefly for overshoes and waterproof clothing. This use has extended to a thousand different forms, the most recent of which is the rubber tire for bicycles and carriages. I can remember in my boyhood the old-fashioned rubber shoe, which was made of pure India rubber directly from the milky juice of the rubber trees, by dipping forms in the shape of the human foot into the juice and drying it in successive layers over an open fire. Now the rubber shoe is generally made of cloth, a great many different pieces, which are made waterproof and adhesive by the application of the mixture of rubber and sulphur, the whole being vulcanized until it becomes one mass. The price of crude rubber has increased to such an extent that there is a great demand for rubber waste, and discarded articles of India rubber are carefully preserved, and I have seen what might almost be called mountains of worn-out rubber shoes waiting at the rubber factory to be recovered and used again. The process is extremely simple: after all the bits of metal have been removed by hand from each shoe, the materials are thrown between corrugated rollers, by which they are torn into small pieces. These are subsequently exposed to the action of hot sulphuric acid of proper strength, by which the cloth is disintegrated and destroyed. The rubber, after being washed and dried, is put in large trays, sprinkled with oil, and subjected to heat in an iron cylinder under pressure, by which it becomes devulcanized and suitable for admixture with fresh rubber.

Another American invention in connection with India rubber is usually attributed to Nelson Goodyear, a nephew of the original inventor. This is the so-called "hard rubber" or "vulcanite." It differs from the ordinary soft vulcanized rubber in two important points. The rubber is mixed with 50 per cent. of sulphur, and the vulcanizing temperature instead of being at or below 275° Fahrenheit, ranges from 275° to 310°. The result is a very hard elastic, sectile, resilient material, of most valuable properties, for which a great many applications have been found, particularly in the construction of electrical apparatus, where its insulating properties are of especial value. I had occasion to study carefully the history of this material, and I have been forced to the conclusion that the real inventor was Austin G. Day; that he was the first person who employed sulphur and rubber alone, and the high temperature above 275°; that the material for which Nelson Goodyear obtained his patent was not vulcanite, but was a mixture of rubber and sulphur with magnesia and other earthy materials; that he never employed a temperature above 275° for vulcanizing, and that the product was brittle and useless.

One of the most important applications of this vulcanite is for mounting artificial porcelain teeth. The material comes in sheets colored red with vermilion. It is warmed to make it plastic, and the set of artificial teeth is made by first making a plaster reproduction of the mouth, fitting into this the warm plastic rubber and the porcelain teeth, and subsequently vulcanizing the whole in the mould. The result is a perfect set of artificial teeth. The expense is so slight as to bring this device within the reach of every one, and the comfort and utility of the invention is incalculable.

The magnitude of the India rubber and gutta percha industry of the United States can be inferred from the fact that in the fiscal year 1898 the imports of crude rubber and gutta percha amounted to 46,055,497 pounds, valued at $25,386,010, while that of the manufactured articles and waste or scrap rubber was 9,488,327 pounds, worth $805,951. A single cargo of rubber, consisting of 1,167 tons, shipped from Para February 23, 1898, was valued at $2,210,000.

CELLULOID.

Celluloid is an American invention, the manufacture of which has assumed very large proportions. A great many attempts were made to employ nitro-cellulose for plastic materials, but no one of them was fairly successful until Mr. Hyatt, of New Jersey, introduced camphor as a solvent. His process consists in nitrating thin tissue paper, reducing this to pulp, mixing it with flaked camphor, with or without pigments, white or colored, moistening the mixture with a small quantity of a solvent for camphor, such as alcohol, then kneading it between steam-heated steel rollers; and then, while it is warm and plastic, giving it any desired form. By exposure to air the solvent evaporates, and it becomes hard and resilient.

The applications of this material are too numerous to mention. What are called celluloid varnishes are now very extensively used, particularly for coating articles of brass. They are solutions of nitrocellulose with or without the addition of other materials in a variety of solvents, such as acetone, wood alcohol, acetate of amyl, etc.

SMOKELESS POWDER.

Smokeless powder is now regularly manufactured for the army and navy of the United States to the extent of from 12,000 to 18,000 pounds daily, from nitrocellulose alone, which is converted into a jelly by proper solvents, placed in cylinders with pistons and forced out through dies in sizes all the way from one-sixteenth of an inch to an inch in diameter, in the form of endless threads or hollow or perforated rods, which are cut up into proper lengths for different sized firearms. Two years ago the army employed a smokeless powder which contained about 25 per cent. nitroglycerine and 75 per cent. nitro-cellulose, but at the present time no nitro-glycerine is employed.

COAL TAR COLORS.

There are now six coal tar color factories in the United States. First, the Buffalo factory of the Schoelkopf, Hartford & Hanna Company. This was established about twenty years ago and is now producing a full line of all kinds of aniline colors, and increasing its variety as the German patents run out. This factory is the largest in America and is maintained up to date in every respect. It employs about 120 workmen. Second, the Hudson River Aniline Company, at Albany, where magenta, blues, and a few other colors are manufactured, chiefly for the use of paper manufacturers. Third, the New Aniline Company, at Albany, N. Y., which manufactures naphthol yellow, benzo-purpurin, and a few other colors. Fourth, Heller & Merz, at Newark, N. J., where a pretty full line of aniline colors are manufactured. Fifth, a small factory at Shady Side, N. J., where naphthol yellow and a few other colors are manufactured. Sixth, the Central Dye Stuff & Chemical Company, at Newark, N. J., where fast red and a few other colors are manufactured.

PRICES AT WHICH SOME COLORS ARE NOW SOLD.

	Cents.
Alizarine red, 20 per cent., paste per pound	10
Benzopurpurine	18
Naphthol yellow	16
Naphthol black	22
Bismarck brown	28
Orange A manufactured by Schoelkopf	15
Chrysoidin	30
Various brands of direct cotton blacks	25 to 30

When I say that the coal tar colors are manufactured in the United States, I must qualify my remark by stating that it would not be possible to manufacture them there under present conditions, were it not that raw materials in the last stage of completion are imported duty free, and the last step of the process is performed in this country, resulting in the development of the color. This industry is possible on account of a 30 per cent. duty on the colors. Even under these circumstances it seems hardly possible that there can be much profit in manufacturing these coloring matters in the United States, when it is considered at what a low price they have to be sold to compete with the importations from Germany and other countries.

MISCELLANEOUS.

Cream of tartar and tartaric acid are produced on a very large scale, owing to the general use of baking powders in the United States. We also manufacture oxalic acid, lactic acid, and lactate of antimony, and we are now manufacturing salicylic acid.

Considerable success has attended our efforts to manufacture the finer chemicals, such as the alkaloids, etc. We manufacture on a considerable scale quinine, strychnine, caffeine, cocaine, colchiceine, pylocardiene and coumarine.

In pharmaceutical preparations our manufacturers excel and large establishments exist now for the manufacture of the digestive ferments, pepsin, pancreatine, etc.

We also manufacture essential oils, especially peppermint and wintergreen.

I have endeavored to give you in this address an account of what the chemists of the United States are doing for the cause of the science which we all love, and which has served to bind us together in this great international Society of Chemical Industry.

The field of usefulness of our science is extremely varied, and is almost unlimited in extent, and contributes most materially to the comfort and health of the human race. In the limited space of an address it is impossible to do justice to it, and I have been obliged to be very brief, and to omit many topics of great importance.

THE DISTANCE TO WHICH THE FIRING OF HEAVY GUNS IS HEARD.

IN a discussion which took place in Nature some time ago on the so-called "Barisâl Guns" and other mysterious sounds, Prof. Hughes suggested that it would be desirable to ascertain how far the firing of guns can be heard. In connection with another subject, that of spurious earthquakes, I have for some time been collecting notes on this point, and I propose here to describe some of the facts obtained, chiefly with regard to the great naval review at Spithead on June 26, 1897, and the operations of the French fleet at Cherbourg on July 18, 1900.

I will mention first a few cases referring to more or less isolated observations of the reports of distant guns. The firing during the battle of Camperdown on October 11, 1797, is said to have been heard in Hull, the distance between the two places being more than 200 miles. A gentleman, formerly resident at Kertch in the Crimea, informs me that he has heard the sound of the guns fired at Sebastopol, distant 158 miles. During the American Civil War, the roar of the guns at the battles of Malvern Hill and Manassas (or Bull Run) was perceptible at Lexington in Virginia, the distances being about 123 and 125 miles respectively (Nature, vol. liii., p. 296). When the "Alabama" was sunk nine miles off Cherbourg on the morning of Sunday, June 19, 1864, the sound of the guns was heard in Jersey, at Clyst St. George, near Exeter (108 miles from Cherbourg), and at Brent Tor, near Bridgewater (about 125 miles). The great naval review at Spithead on July 17, 1867, was held during rough, boisterous weather; but the noise of the guns is said to have been heard at Exeter (105 miles), Morebath, near Tiverton (105 miles), Great Malvern (107 miles), and Castle Frome in Herefordshire (110 miles). In all the above cases the sound was, of course, the aggregate of that of many guns of different sizes fired simultaneously. But, in naval reviews, the charge is very much less than in actual warfare; a 6-inch gun, for instance, would fire a blank charge of 7 pounds, whereas the service charge for the same gun would be 48 pounds fired with shot.

With regard to the distance to which the report of a single gun can be heard, I have very little information. A 110-ton gun fired at Woolwich made a window shake at Chignall St. James (24 miles), and was heard at Witham (32 miles) as a rumbling sound which seemed to deafen the observer slightly (Nature, vol. xli. p. 369). Time guns at Bombay have been often heard at the northern Mahim, distant more than 50 miles (vol. lvi. p. 223). The reports of the heavy guns at the battle of Malvern Hill, mentioned above, could be easily distinguished at Lexington from those of the smaller weapons; and a similar observation is recorded below. The subject is evidently one on which useful contributions to our knowledge might be made by residents near the south coast of England.

NAVAL REVIEW AT SPITHEAD ON JUNE 26, 1897.

Shortly before the great naval review held in honor of the Queen's Diamond Jubilee, I wrote to the principal London newspapers and to several published in the south of England, and I have to thank the editors of these papers, and the ladies and gentlemen who replied to my inquiries, for the help they have kindly given me. The points to which I directed attention were the times at which the reports were heard, whether the air-vibrations were strong enough to make windows rattle, the direction from which the sound appeared to come, and the direction of the wind.

The fleet collected on this occasion consisted of 165 vessels of war of all classes arranged in five lines about six miles in length. The position of the flag-ship (H. M.S. "Renown") was about two miles N. 20° E. of Ryde; and the distances given below are all measured from this point. As the royal yacht entered the lines immediately after 2 P.M., the first shot was fired from the "Renown," and was taken up by other ships in turn, each firing a royal salute of twenty-one guns. "The heaviest gun employed," I am informed by the Secretary of the Admiralty, "was probably a 6-inch breech-loading gun, firing a blank charge of 7 pounds," but others of different sizes were also used. It produced at first a dull crackling noise, according to a correspondent on H.M.S. "Sanspareil," but, as ship after ship took up the salute, the firing grew more animated and the roll of the guns louder; until, after about five minutes, the report of the last gun died away.

The atmospheric conditions were fairly favorable for the propagation of the sound. Light but variable breezes, generally between northeast and southeast, prevailed over most of the south of England. The thunderstorms which occurred on that day followed the salute in most places, but nearly all my correspondents (several being retired military officers) agreed that the sound of the guns could be readily distinguished from that of thunder.

In many of the records which I have received, the time is given so roughly that it is difficult to feel confident that they refer to the salute in question, and in several it is omitted altogether. Under the former heading come records from Honiton (90 miles from Spithead) and Shebbear, near Torrington (135 miles); and under the latter from near Rickmansworth (67 miles) and Great Malvern (107 miles). Excluding all such cases, the number of records is reduced to twenty from nineteen places.

At very few of these places, and at none more distant than about 28 miles, were the vibrations strong enough to shake windows. Distinct reports were heard at the

beginning and end of the salute as far as Farnham (34 miles), otherwise the sound was a dull, continuous roar, with occasional booms from the heavier guns. The sound was heard to the east as far as Framfield (57½ miles), to the northeast at Wimbledon (62 miles), to the north at Bloxham Green, near Banbury (88 miles), and to the west at Wellington, in Somerset (93 miles). These are more or less isolated places, but there is a fairly continuous series of observations in a northwesterly direction, extending to Melksham (61 miles), Monkton Farleigh, near Bradford-on-Avon (67 miles), Bath (two observations, 69 miles), and Weston, near Bath (71 miles).

In the evening the fleet was illuminated, and a final royal salute, similar to that at 2 P. M., was fired on the return of the Prince of Wales shortly after 11 P. M. I have only two accounts which may refer to this salute, one from Cosham in Hampshire at 11:30 P. M., the other from Ashburton in Devonshire (116 miles) at 11:59 P. M. The recorded times differ too widely to give much value to these observations.

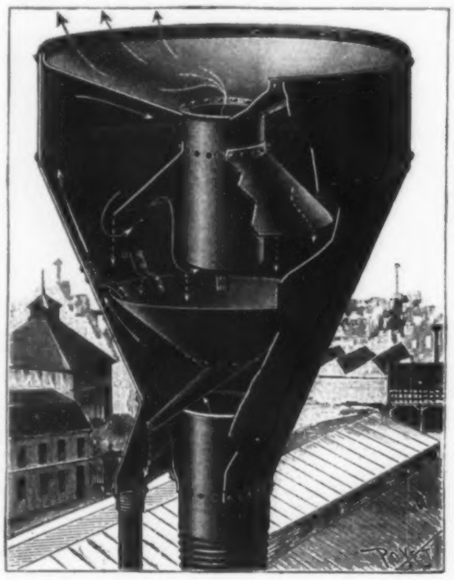
NAVAL REVIEW AT CHERBOURG ON JULY 18, 1900.

About 10 P. M. a sham fight took place between two portions of the French fleet at Cherbourg in honor of the visit of the President, M. Loubet, to that town. The number of vessels engaged was forty-three, including thirteen of the largest and most modern battleships in the world. During the next few days accounts appeared in various English newspapers of a series of supposed earthquake shocks felt shortly after 10 P. M. at different places along the southern coast, from Torquay to Bognor. The long duration of the disturbances and their apparent transmission through the air being opposed to a seismic origin, I wrote letters to a number of London and south-country papers, and the account which follows is chiefly based on the replies which I received to these letters.

As some doubt has been expressed with regard to the connection between the two phenomena, it may be well to mention the evidence in its favor. 1. With two exceptions, not one of the places (forty in number) from which records have come is more than a mile or two from the coast. There are several from the south of the Isle of Wight, but none from that part of Hampshire shielded from Cherbourg by the higher ground of the island. 2. Though a few persons in the open air assert that a tremor was felt, the great majority state that the sound traveled through the air and not through the ground; windows rattled loudly without there being any movement of the floor, and at Lancing (100 miles from Cherbourg) and Seaton in Devon (97 miles) observers placing their hands on the wall felt it distinctly vibrating; the noise caused a drumming in the ears at several places more than a hundred miles from Cherbourg. 3. The sounds were recognized as those of heavy guns by many persons, and with less hesitation the smaller the distance from Cherbourg. 4. The night was very still, hardly a breath of wind could be felt, and the sea perfectly calm; and the sound was heard to the east and west along the English coast at almost equal distances from Cherbourg. 5. Lastly, heavy guns are rarely, if ever, fired from English ships or forts at so late an hour; whereas more than 24,000 charges are said to have been fired in Cherbourg Harbor during almost the same interval in which the sounds were heard in England.

Though the times of occurrence are roughly given, they agree for the most part in placing the commencement of the disturbances just after 10 P. M., and the end shortly before 10:30. Clearer evidence as to the identity of the sounds throughout the whole area affected is provided by the similarity in their relative duration and intensity. The first began about 10:02 or 10:03, and lasted nearly four minutes. Then came a pause of five minutes, when there was another burst of about the same intensity and nearly the same duration. About ten minutes later the third followed, slighter in intensity and of shorter duration, perceived almost as far as the others (at Torquay and Brighton, 101 and 104 miles respectively), though not by all observers.

I have no information as to the size of the guns used on this occasion, but they were probably much heavier than those employed for the salutes at Spithead in 1897. To the west, the sound was heard at Budleigh Salterton, Sidmouth and Torquay (101 miles from Cherbourg), Paignton (102 miles), and Dawlish and Exmouth (104 miles); to the east at Lancing (100 miles), Brighton (104 miles), and near Henfield (107 miles and 7 miles from the sea). At all of these places, and at many between, the air vibrations were strong enough to make windows shake and rattle, and there are accounts of this or a similar effect being observed at a greater distance than the sound—at Plymouth (123 miles), and Menheniot, near Liskeard (136 miles, and 5



APPARATUS FOR CONDENSING EXHAUST STEAM.

miles from the sea). At the latter place the sudden rattle of a large window was distinctly heard at about 10 P. M., but it was unaccompanied by any sound. Judging from the intensity of the disturbances at Torquay and Brighton, I see no reason to doubt the connection of the latter observation with the firing at Cherbourg.

It is interesting to notice how the character of the sound changed with the increasing distance from Cherbourg. At St. Catherine's Point (65 miles) and Bonchurch (68 miles), both in the Isle of Wight, the sound was described as exactly like that of heavy guns. At Bournemouth and Muddiford in Hampshire (74 miles) there was a continual rumbling noise, with occasional heavier booms. At greater distances, as far as Lancing, Torquay and Paignton, the prominent reports ceased to be audible, and there was merely a deep monotonous throbbing noise, the pulsations recurring with great rapidity and regularity, resembling a very quick beating of a big drum far away, or the beats of the paddles of a distant and unseen steamer. At very great distances the vibrations (or some of them) do not seem to have attained the requisite strength to be audible to certain observers, one at Lancing (100 miles) referring to a most curious throbbing sensation in the air, and a dull sound like that of a distant train; while another at Brighton (104 miles) remarks that he heard or felt the sound. The rattling of the windows and inaudibility of the vibrations at Menheniot may perhaps be accounted for in this way.—Charles Davison in Nature.

APPARATUS FOR CONDENSING EXHAUST STEAM.

STEAM, in escaping, after acting in the engine and traversing the condensing apparatus, carries along with it water and oil, which, in falling in the open air, are capable of injuring the roofs and walls in the vicinity.

To prevent such an inconvenience, many apparatus have been devised, the most recent of which is one described in The Street Railway Journal and figured herewith. As may be seen, it consists of a large funnel which rests upon the exhaust pipe and is provided at the side with a special conduit. Directly above the exhaust pipe there is a small funnel which empties into the lateral conduit. Above and in the central part is fixed a vertical pipe held in position by a funnel-shaped sheet of iron, beneath which this same pipe carries an inverted funnel.

As shown by the arrows, the exhaust steam enters through the eduction pipe, impinges against the sides of the lowermost funnel and then against those of the inverted one and falls back in the form of drops of water and oil, which flow into the lateral conduit. The small quantity of steam that escapes condensation below is condensed at the upper part; so that the quantity of pure and completely dry steam that enters the atmosphere is very small.

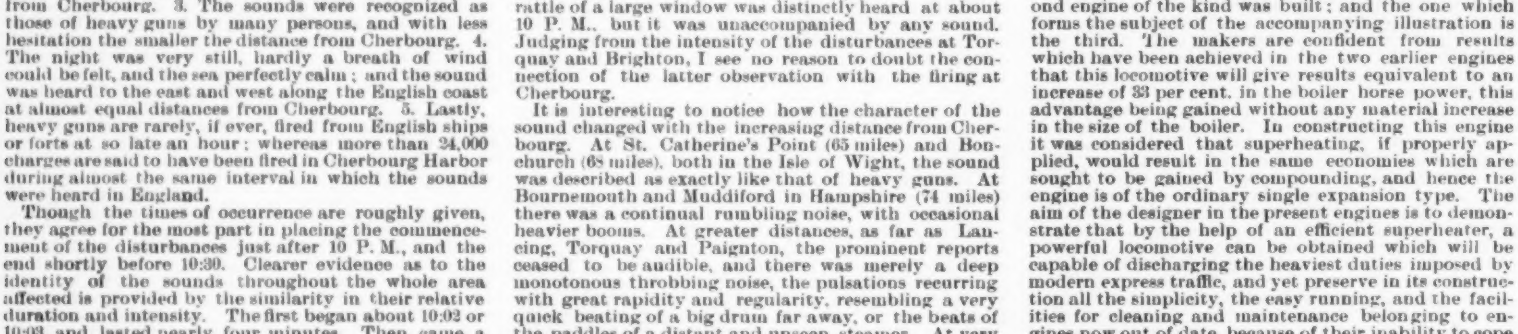
The apparatus has the advantage of creating no counter-pressure and of operating in a perfectly silent manner.—La Nature.

A BORSIG LOCOMOTIVE WITH SUPERHEATER.

THE losses due to cylinder condensation, which occur in the steam engine of the reciprocating type, are perhaps more marked in locomotives than in any other form of steam engines, and hence it is not surprising that a considerable amount of activity is being shown among locomotive engineers in the designing of a superheater that will secure good economical results, and at the same time lend itself, both in construction and operation, to the necessities of locomotive design.

The first locomotive to be built with a superheater was constructed two years ago at the Vulcan Works, Stettin. This engine is being worked in express service on the Hanover line, and it is said that, in view of the fact that it was the first experimental machine constructed, the results are highly satisfactory. A second engine of the kind was built; and the one which forms the subject of the accompanying illustration is the third. The makers are confident from results which have been achieved in the two earlier engines that this locomotive will give results equivalent to an increase of 33 per cent. in the boiler horse power, this advantage being gained without any material increase in the size of the boiler. In constructing this engine it was considered that superheating, if properly applied, would result in the same economies which are sought to be gained by compounding, and hence the engine is of the ordinary single expansion type. The aim of the designer in the present engines is to demonstrate that by the help of an efficient superheater, a powerful locomotive can be obtained which will be capable of discharging the heaviest duties imposed by modern express traffic, and yet preserve in its construction all the simplicity, the easy running, and the facilities for cleaning and maintenance belonging to engines now out of date because of their inability to cope with modern demands.

The engine is of the eight-wheeled type, with four coupled driving wheels and a four-wheeled truck. The drivers are 6 feet 6 inches in diameter. There are two outside cylinders 20 inches in diameter by 24 inches stroke. The working pressure is 170 pounds, and the heating surface, exclusive of the superheating tubes, is



BORSIG LOCOMOTIVE WITH SUPERHEATER, SHOWN AT THE PARIS EXPOSITION.

1,167 square feet, the grate surface is 24½ square feet, and the superheating surface 301 square feet, or slightly over 25 per cent. of the ordinary steaming surface. When in running order, the locomotive weighs about 56 tons, 31 tons of which are on the drivers. The firebox is of ordinary construction, in fact, the locomotive is throughout of the standard Prussian State Railways pattern for two-cylinder express engines, except so far as it has been modified by the introduction of a superheater.

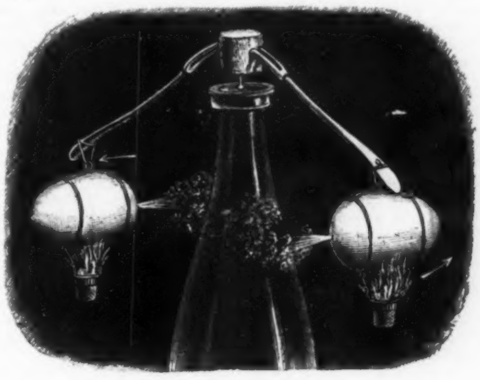
The superheater is placed entirely within the smokebox, which is formed of an outer shell 5 feet 7 inches in diameter and an inside shell 4 feet 4 inches in diameter, the annular space thus formed being 7½ inches in width and about 5 feet in length, or somewhat less than the length of the smokebox. This annular space forms the superheating chamber, and into its lower part there passes, by means of a 10 inch tube, a considerable portion of the furnace gases, which are led by this tube to the superheater direct from the firebox, the tube lying near the bottom of the barrel and taking the place of about fifteen ordinary boiler tubes. While the 10-inch tube, passing, as it does, through the water space in the boiler, does its share of the work as heating surface, its large diameter insures that the hot gases will give up but a comparatively small portion of their heat before they reach the superheater.

It should be explained that the upper edges of the inner shell above referred to turn upward at the top of the smokebox to meet the outer shell at a distance apart of 3 feet 9 inches, thus forming a gap in the annular heating chamber through which the smokestack passes. In the sides of the gap and facing the smokestack there are a number of port holes covered by flap valves which can be opened or closed and regulated from the cab. When they are closed, the circulation of furnace gas through the superheating chamber is stopped. The superheating chamber is filled with a nest of sixty tubes of 1⅛ inches outside diameter, which are bent to conform to the curvature of the superheating chamber and are riveted at their ends to two steam boxes, which are placed on the top of the smokebox, and occupy the raised semi-circular drum which will be noticed in our engraving. As the gases find their escape only by the flap valves which lead from the smokebox to the superheater, they are forced to travel over its nest of tubes. The steam box to the right hand of the stack is divided into rearward and forward portions by a transverse diaphragm. The steam from the boiler enters the rearward portion, and it travels downward through thirty of the superheating tubes, rising again in those on the left-hand side of the smokebox and being discharged into the left-hand steam box. This box has no transverse diaphragm, so that it allows the steam to pass forward from the first thirty tubes and into the remaining thirty. It descends these latter on the left hand and is thus obliged to traverse the whole circle of the superheating chamber a second time, and rising on the right hand of the stack it is discharged into the forward division of the right-hand steam box, from whence it is led to the two cylinder valve chests.

This superheater is said to be capable of bringing steam of 180 pounds pressure up to a temperature of 626° F., the hot gases being estimated to be cooled about 1,470° F. in passing through the superheater. It is estimated that with this device the Borsig locomotive will show a saving in the coal bill of 25 per cent., and a saving of 33 per cent. in the amount of water used.—For our illustrations and particulars we are indebted to The Engineer.

A MINIATURE STEAM MERRY-GO-ROUND.

IN performing the experiment pictured in the accompanying illustration, two eggs are employed, the contents of which have been sucked out through the usual pinhole. About each egg a thin wire is wound so as to form a supporting frame, the upper part of which is provided with a small eye and the lower part with



A TOY MERRY-GO-ROUND.

two small hooks. Upon the hooks a thimble is hung which has been previously provided with the necessary engaging devices. In this manner two miniature airships are produced, the gas bags of which are represented by the egg-shells; and the cars by the thimbles.

The two shells are half filled with water by plunging them, while in a slightly heated condition, in cold water.

Upon the neck of the bottle a coin of suitable size is placed, which coin serves as a pivot for a pin thrust through the bottom of a cork. In the opposite sides of the cork two forks are forced, the handles of which support the egg-shells by means of a loop of wire slipped through the eye of the wire frame. The egg-shells half filled with water, the forks, and the cork are supported in equilibrium on the coin by the pin previously mentioned, but in such a manner that the entire arrangement can rotate on the pin as an axis.

The thimbles are filled with cotton soaked in alcohol. Should the two sides of the apparatus not be balanced, shot can be dropped into the proper thimble. The alcohol-soaked cotton is ignited; and in a short time the water in the egg-shells begins to boil. The reaction of the steam which escapes from the pinholes causes the entire apparatus to turn upon its axis with a speed which constantly increases until the alcohol has been entirely consumed.

THE NEW FIRST-CLASS AUSTRIAN COAST-DEFENSE BATTLESHIP "HABSBURG."

THE new Austrian battleship which is now in the course of construction at the wharves of the Stabilimento Tecnico Triestino, and which is to bear the name "Habsburg," is the first of a series of ships authorized by the Austro-Hungarian government. The "Habsburg" is a coast-defense vessel of 8,340 tons displacement, 354 feet in length and 65 feet 9 inches in beam. She will draw 23 feet, will have engines of 11,000 indicated horse power, which will drive her at a speed of 18 knots. The armor will consist of a belt of chrome-nickel steel 8·6 inches thick, extending four-fifths of the ship's length. The gun positions are protected by 8·2 inches of armor plating. The deck plating is composed of 2⅓-inch steel. The armament will be composed of three 9·4-inch rapid-fire guns, mounted in turrets, two forward and one aft; twelve 5·9-inch rapid-firing guns, mounted in two superposed rows so that four guns can be directed aft, four forward, and six to each side; and twenty-four smaller guns of various sizes.—Our illustration is taken from the Illustrirte Zeitung.

COMMERCE WITH HAWAII.

THE people of the United States are likely to be deprived of some much desired information regarding the commerce of the United States with the Hawaiian Islands. The recent Act of Congress, which extended to these islands practically all of the laws of the United States, is construed as rendering the commerce between the United States and the islands "coastwise" in its character. The laws with reference to the gathering of statistics of our commerce require importers and exporters to file with the collectors of customs at the ports at which their goods enter or at which they leave the country, a specific statement of the quantity and value of each article imported or exported. The law does not require, however, this detailed information with reference to goods passing from one port of the United States to another port of the United States. Taking advantage of this condition, merchants of San Francisco, who are engaged in the trade with the Hawaiian Islands, are refusing to furnish to the collector at that point, regarding goods sent to or from the Hawaiian Islands, the general class of information which they have for years been furnishing, but from which they claim they are now exempt under the new conditions.

The effect of this will be to deprive the Bureau of Statistics and the people of the United States, at present at least, of all information regarding the commerce with the Hawaiian Islands. No feature of our import and export trade has attracted so much attention during the past year as that with the Hawaiian Islands. It was one spot where the effect of annexation upon commerce with the territory annexed could be studied, since, in the other territories brought into close relations with the United States, conditions were not in our favor by reason of the war which had existed previous to or immediately following the new relationship. While the growth of our commerce with Porto

THE NEW AUSTRIAN COAST-DEFENSE BATTLESHIP "HABSBURG."

Rico, Cuba and the Philippine Islands had been very great, it has been difficult to determine what proportion of the growth was due to war conditions or what proportion to the new relations thus established. In the case of the Hawaiian Islands, however, no war conditions existed, either previous or subsequent to annexation, and the growth of the commerce with the United States may be attributed, chiefly, if not wholly, to the close relations brought about by annexation and the general business revival which followed that event.

The growth of commerce with the Hawaiian Islands in the last few years, especially in the years 1899 and 1900, has been phenomenal. This growth is especially interesting in view of the new relationship which has been established with the islands and the marked increase which accompanied the final determination of that event. In 1890 the exports of the United States to the Hawaiian Islands were $4,711,417 and in 1897 were $4,690,075, showing no growth from 1890 to 1897. In 1890 the imports into the United States from the Hawaiian Islands were $12,312,098 and in 1897 were $13,687,799, showing but a slight growth.

The treaty of annexation was signed at Washington, June 16, 1897, so that all the commerce of the fiscal year 1898 felt the effect of that step in the process of annexation. In that year the exports of the United States to the Hawaiian Islands were $5,907,155, an increase of 27 per cent. over 1897, when they amounted to $4,690,075. The treaty was ratified July 7, 1898, and sovereignty over the islands formally transferred to the United States on August 12, 1898, thus bringing practically all of the fiscal year 1899 within the period following the complete annexation. The exports to the Hawaiian Islands in the fiscal year 1899 amounted to $9,305,470, an increase of over 50 per cent. On the import side, the year 1898 showed an increase of $3,500,000 over 1897, and the year 1900 showed another increase of $3,500,000 over 1898 and 1899.

THE MODERN SYSTEM OF TEACHING PRACTICAL INORGANIC CHEMISTRY AND ITS DEVELOPMENT.*

IN choosing for the subject of my address to-day the development of the teaching of practical inorganic chemistry, I do so, not only on account of the great importance of the subject, but also because it does not appear that this matter has been brought before this Section, in the President's address at all events, during the last few years.

In dealing generally with the subject of the teaching of chemistry as a branch of science, it may be well in the first place to consider the value of such teaching as a means of general education, and to turn our attention for a few minutes to the development of the teaching of science in schools.

There can be no doubt that there has been great progress in the teaching of science in schools during the last forty years, and this is very evident from the perusal of the essay, entitled "Education: Intellectual, Moral, and Physical," which Herbert Spencer wrote in 1859. After giving his reasons for considering the study of science of primary importance in education, Herbert Spencer continues: "While what we call civilization could never have arisen had it not been for science, science forms scarcely an appreciable element in our so called civilized training."

From this it is apparent that science was not taught to any appreciable extent in schools at that date, though doubtless in some few schools occasional lectures were given on such scientific subjects as physiology, anatomy, astronomy, and mechanics.

Herbert Spencer's pamphlet appears to have had only a very gradual effect toward the introduction of science into schemes of education. For many years chemical instruction was only given in schools at the schoolroom desk, or at the best from the lecture table, and many of the most modern of schools had no laboratories.

The first school to give any practical instruction in chemistry was apparently the City of London School, at which, in the year 1847, Mr. Hall was appointed teacher of chemistry, and there he continued to teach until 1869.† Besides the lecture theater and a room for storing apparatus, Mr. Hall's department contained a long room, or rather passage, leading into the lecture theater, and closed at each end with glass doors. In this room, which was fitted up as a laboratory and used principally as a preparation room for the lectures, Mr. Hall performed experiments with the few boys who assisted him with his lectures. As accommodation was at that time strictly limited, he used to suggest simple experiments and encourage the boys to carry them out at home, and afterward he himself would examine the substances which they had made.

From this small beginning the teaching of chemistry in the City of London School rapidly developed, and this school now possesses laboratories which compare favorably with those of any school in the country.

The Manchester Grammar School appears to have been one of the first to teach practical chemistry. In connection with this school a small laboratory was built in 1868; this was replaced by a larger one in 1872, and the present large laboratories, under the charge of Mr. Francis Jones, were opened in 1880.

Dr. Marshall Watts, who was the first science master in this school, taught practical chemistry along with the theoretical work from the commencement in 1868.

As laboratories were gradually multiplied, it might be supposed that boys were given the opportunity to carry out experiments which had a close connection with their lecture room courses. But the programme of laboratory work which became all but universal was the preparation of a few gases, followed by the practice of qualitative analysis. The course adopted seems to have been largely built up on the best books of practical chemistry in use in the colleges at that time; but it was also, no doubt, largely influenced by the requirements of the syllabus of the Science and Art Department, which contained a scheme for teaching practical chemistry.* Even down to quite recent times it was in many schools still not considered essential that boys should have practical instruction in connection with lectures in chemistry.

A report issued in 1897 by a special committee appointed by the Technical Education Board of the London County Council adduces evidence of this from twenty-five secondary schools in London, in which there were 3,960 boys learning chemistry. Of these, 1,698 boys, or 43 per cent., did no practical work whatever; 955 boys, or 24 per cent., did practical work, consisting of a certain amount of preparation of gases, together with qualitative analysis; but of these latter, 743, or 77 per cent., had not reached the study of the metals in their theoretical work, so that their testing work can have been of little educational value. It was also found that in the case of 655, or 68 per cent. of the total number of boys taking practical work, the first introduction to practical chemistry was through qualitative analysis.

But some years before this report was issued a movement had begun which was destined to have a far-reaching effect. A report "on the best means for promoting scientific education in schools" having been presented to the Dundee meeting of this association in 1867, and published in 1868, a committee of the British Association was appointed in 1887 "for the purpose of inquiring and reporting upon the present methods of teaching chemistry." The well-known report which this committee presented to the Newcastle meeting in 1889 insisted that it was worth while to teach chemistry in schools, not so much for the usefulness of the information imparted as for the special mental discipline it afforded if the scientific method of investigating nature were employed. It was argued that "learners should be put in the attitude of discoverers, and led to make observations, experiments, and inferences for themselves." And since there can be little progress without measurement, it was pointed out that the experimental work would necessarily be largely of a quantitative character.

Prof. H. E. Armstrong, in a paper read at a conference at the Health Exhibition five years before this, had foreshadowed much that was in this report. He also drew up a detailed scheme for "a course of elementary instruction in physical science," which was included in the report of the committee, and it cannot be doubted that this scheme and the labors of the committee have had a very marked influence on the development of the teaching of practical chemistry in schools. That this influence has been great will be admitted, when it is understood that schemes based on the recommendation of the committee are now included in the codes of both elementary day schools and evening continuation schools. The recent syllabuses for elementary and advanced courses issued by the Incorporated Association of Headmasters and by the Oxford and Cambridge local boards and others are evidently directly inspired by the ideas set forth by the committee.

The Department of Science and Art has also adopted some of the suggestions of the committee, and a revised syllabus was issued by the department in 1895, in which qualitative analysis is replaced by quantitative experiments of a simple form, and by other exercises so framed "as to prevent answers being given by students who have obtained their information from books or oral instruction." This was a very considerable advance, but it must be admitted that there is nothing in the syllabus which encourages, or even suggests, placing the learners in the attitude of discoverers, and this, in the opinion of the committee of this association, is vital if the teaching is to have educational value.

Many criticisms have been passed upon the 1889 report. It has been said that life is much too short to allow of each individual advancing from the known to the unknown, according to scientific methods, and that even were this not so, too severe a tax is made upon the powers of boys and girls. In answer to the second point, it will be conceded that while it is doubtless futile to try to teach chemistry to young children, on the other hand experience has abundantly shown that the average schoolboy of fourteen or fifteen can, with much success, investigate such problems as were studied in the researches of Black and Scheele, of Priestly, and Cavendish, and Lavoisier, and it is quite remarkable with what interest such young students carry out this class of work.

It may be well to quote the words which Sir Michael Foster used in this connection in his admirable presidential address to this association in 1899. He said: "The learner may be led to old truths, even the oldest, in more ways than one. He may be brought abruptly to a truth in its finished form, coming straight to it like a thief climbing over a wall; and the hurry and press of modern life tempt many to adopt this quicker way. Or he may be more slowly guided along the path by which the truth was reached by him who first laid hold of it. It is by this latter way of learning the truth, and by this alone, that the learner may hope to catch something at least of the spirit of the scientific inquirer."

I believe that in the determination of a suitable school course in experimental science this principle of historical development is a very valuable guide, although it is not laid down in the 1889 Report of the British Association.

The application of this principle will lead to the study of the solvent action of water, of crystallization, and of the separation of mixtures of solids before the investigation of the composition of water, and also before the investigation of the phenomena of combustion. It will lead to the investigation of hydrochloric acid before chlorine, and especially to the postponement of atomic and molecular theories, chemical equations, and the laws of chemical combination, until the student has really sufficient knowledge to understand how these theories came to be necessary.

There can be no doubt that this new system of teaching chemistry in schools has been most successful. Teachers are delighted with the results which have already been obtained, and those whom I have had the opportunity of consulting, directly or indirectly, cannot speak too highly of their satisfaction at the disappearance of the old system of qualitative analysis and the institution of the new order of things. Especially I may mention in this connection the excellent work which is being carried on under the supervision of Dr. Bevan Lean at the Friends' School in Ackworth, where the boys have attained results which are far in advance of anything which would have been thought possible a few years since.

It is, of course, obvious that if a schoolboy is made to take the attitude of a discoverer, his progress may appear to be slow. But does this matter? Most boys will not become professional chemists; but if while at school a boy learns how to learn, and how to "make knowledge"* by working out for himself a few problems, a habit of mind will be formed which will enable him in future years to look in a scientific spirit at any new problems which may face him. When school days are past the details of the preparation of hydrogen may have been forgotten; but if it was really understood at the time that it could not be decided at once whether the gas was derived from the acid, or from the metal, or from the water, or in part from the one and in part from the other, an attitude of skepticism and of suspended judgment will have been formed, which will continue to guard from error.

In the new system of teaching chemistry in schools much attention must necessarily be given to weights and measurements; indeed, the work must be largely of a quantitative kind, and it is in this connection that an important note of warning has been sounded by several teachers.† They consider, very rightly, that it is important to point out clearly to the scholar that science does not consist of measurement, but that measurement is only a tool in the hand of the inquirer, and that when once sufficient skill has been developed in its use it should be employed only with a distinct object. Measurements should, in fact, be made only in reference to some actual problem which appears to be really worth solving, not in the accumulation of aimless details.

And, of course, all research carried out must be genuine and not sham, and all assumption of the "obvious" must be most carefully guarded against. But the young scholar must, at the same time, not forget that although the scientific method is necessary to enable him to arrive at a result, in real life it is the answer to the problem which is of the most importance.‡

Although, then, there has been so much discussion, during the last ten years, on the subject of teaching chemistry in schools, and such steady progress has been made toward devising a really satisfactory system of teaching the subject to young boys and girls, it is certainly very remarkable that practically nothing has been said or written bearing on the training which a student who wishes to become a chemist is to undertake at the close of his school days at the college or university in which his education is continued.

One of the most remarkable points, to my mind, in connection with the teaching of chemistry, is the fact that although the science has been advancing year by year with such unexampled rapidity, the course of training which the student goes through during his first two years at most colleges is still practically the same as it was thirty or forty years ago. Then, as now, after preparing a few of the principal gases, the student devotes the bulk of his first year to qualitative analysis in the dry and wet way, and his second year to quantitative analysis; and, although the methods employed in teaching the latter may possibly have undergone some slight modification, there is certainly no great difference between the routine of simple salt and mixture followed by quantitative analysis practised at the present day and that which was in vogue in the days of our fathers and grandfathers.

Since, then, the present system has held the field for so long, not only in this country but also on the Continent, it is worth while considering whether it affords the best training which a student who wishes to become a chemist can undergo in the short time during which he can attend at a college or university. In considering this matter I was led in the first place to carefully examine old books and other records with the object of finding out how the present system originated, and I think that valuable and interesting information bearing on the subject may be obtained from a very brief sketch of the rise and development of the present system of teaching chemistry, and especially in so far as it bears on the inclusion of qualitative analysis. Unfortunately, it is not so easy to gain a good historical acquaintance with the matter as I at first imagined would be the case, and this is due in a large measure to the fact that so few of the laboratories which took an active part in the development of the present system of chemical training have left any record of the methods which they employed. In this connection I may, perhaps, be allowed to suggest that it would be a valuable help to the future historian if all prominent teachers of chemistry would leave behind them a brief record of the system of teaching adopted in their laboratories, showing the changes which they had instituted, the object of these changes, and the results which followed their adoption.

There is no doubt that the progress of practical chemistry went largely hand in hand with the progress of theoretical chemistry, for as the latter gradually developed, so the necessity for the determination of the composition, first of the best known, and then of the rarer minerals and other substances, became more and more marked.

The analytical examination of substances in the dry way was employed in very early times in connection with metallurgical operations, and especially in the determination of the presence of valuable constituents in samples of minerals. Cupellation was used by the Greeks in the separation of gold and silver from their ores and in the purification of these metals. Geber knew that the addition of niter to the ore facilitated the separation of gold and silver, and subsequently Glauber (1604–1668) called attention to the fact that many commoner metals could easily be separated from their ores with the aid of niter.

But it was not till the eighteenth century that any marked progress was made in analysis in the dry way, and the progress which then became rapid was un-

* Opening address by Prof. W. H. Perkin, Jr., Ph.D., F.R.S., President of the Section of Chemistry, British Association.

† Mr. A. T. Pollard, M.A., Head Master of the City of London School, has kindly instituted a search among the bound copies of the boys' terminal reports, and informs me that in the school form of terminal report a heading for chemistry was introduced in the year 1847, the year of Mr. Hall's appointment.

* I find, on inquiry, that examinations in the Advanced Stage and Honors of Practical Chemistry were first held by the Science and Art Department in 1878, the practical examination being extended to the elementary stage in 1882.

* Cf. Prof. J. G. Macgregor in Nature, September, 1899.

† Cf. H. Picton in The School World, November, 1899; Bevan Lean, ibid., February, 1900.

‡ Cf. Mrs. Bryant, "Special Reports on Educational Subjects," vol. ii., p. 113.

doubtedly due to the discovery of the blowpipe, and to the introduction of its use into analytical operations. The blowpipe is mentioned for the first time in 1660, in the transactions of the Accademia del Cimento of Florence, but the first to recommend its use in chemical operations was Johann Andreas Cramer in 1739. The progress of blowpipe analysis was largely due to Gahn (1745–1818), who spent much time in perfecting its use in the examination of minerals, and it was he who first used platinum wire and cobalt solution in connection with blowpipe analysis. The methods employed by Gahn were further developed by his friend Berzelius (1779–1848), who gave much attention to the matter, and who with great skill and patience gradually worked out a complete scheme of blowpipe analysis, and published it in a pamphlet, entitled "Ueber die Anwendung des Löthrohrs," which appeared in 1820. After the publication of this work blowpipe analysis rapidly came into general use in England, France and Germany, and the scheme devised by Berzelius is essentially that employed at the present day.

Indeed, the only notable additions to the methods of analysis in the dry way since the time of Berzelius are the development of flame reactions, which Bunsen worked out with such characteristic skill and ingenuity, and the introduction of the spectroscope.

The necessity for some process other than that of analysis in the dry way seems, in the first instance, to have arisen in quite early times in connection with the examination of drugs, not only on account of the necessity for discovering their constituents, but also as a means of determining whether they were adulterated. In such cases analysis in the dry way was obviously unsuitable, and experience soon showed that the only way to arrive at the desired result was to treat the substance under examination with aqueous solutions of definite substances, the first reagent apparently being a decoction of gallnuts, which is described by Pliny as being employed in detecting adulteration with green vitriol.

The progress made in connection with wet analysis was, however, exceedingly slow, largely owing to the lack of reagents; but as these were gradually discovered wet analysis rapidly developed, especially in the hands of Tachenius, Scheele, Boyle, Hoffman, Margraf and Bergmann. Boyle (1626–1691) especially had an extensive knowledge of reagents and their application; and, indeed, it was Boyle who first introduced the word "analysis" for those operations by which substances may be recognized in the presence of one another. Boyle knew how to test for silver with hydrochloric acid, for calcium salts with sulphuric acid, and for copper by the blue solution produced by ammonia.

Margraf (1709–1782) introduced prussiate of potash for the detection of iron, and Bergmann (1735–1784) not only introduced new reagents and new methods for decomposing minerals and refractory substances, such as fusion with potash, digestion with nitric acid or hydrochloric acid, but he also was the first to suggest the application of tests in a systematic way, and, indeed, the method of analysis which he developed is on much the same lines as that in use at the present day. He paid special attention to the qualitative analysis of minerals, and gave careful instructions for the analysis of gold, platinum, silver, lead, copper, zinc, and other ores. The work of Scheele (1742–1786) had indirectly a great influence on qualitative analysis, as, although he did not give a general systematic method of procedure in the analysis of substances of unknown composition, yet the methods which he employed in the examination of new substances were so original and exact as to remain models of how qualitative analysis should be conducted.

Great strides in analytical chemistry in the wet way were made through the work of Berzelius, who, by the discovery of new methods, such as the decomposition of silicates by hydrofluoric acid and the introduction of new tests, greatly advanced the art. He paid special attention to perfecting the methods of analysis of mineral waters, and these researches, as well as his work on ores, and particularly his investigation of platinum ores, stamp Berzelius as one of the great pioneers in qualitative and quantitative analytical chemistry.

By the labors of the great experimenters whom I have mentioned qualitative analysis gradually acquired the familiar appearance of to-day, and many books were written with the object of arranging the mass of information which had accumulated, and of thus rendering it available for the student in his efforts to investigate the composition of new minerals and other substances. Among these books may be mentioned the "Handbuch der Analytischen Chemie," by H. Rose, and especially the well known analytical text books of Fresenius, which have had an extraordinarily wide circulation and passed through many editions.

The work of the great pioneers in analytical chemistry was work done often under circumstances of great difficulty, as before the end of the seventeenth century there were no public institutions of any sort in which a practical knowledge of chemistry could be acquired. Lectures were, of course, given from very early times, but it was not until the time of Guillaume François Rouelle (1703–1770), at the beginning of the eighteenth century, that lectures began to be illustrated by experiments. Rouelle, who was very active as a teacher, numbered among his pupils many men of eminence, such as Lavoisier and Proust, and it was largely owing to his influence that France took such a lead in practical teaching. In Germany progress was much slower, and in our country the introduction of lectures illustrated by experiments seems to have been mainly due to Davy.

(To be continued.)

German Rubber Association.—Consul-General Guenther, of Frankfort, under date of August 23, 1900, writes:

The German Rubber Goods Manufacturers' Association held its annual meeting last month. Forty factories are represented in the association, of which sixteen employ under 100 hands, sixteen employ between 100 and 500, and eight employ over 500. All important German concerns are connected with the institution, which wields a powerful influence. The association has been consulted by the government about the new tariffs to be arranged this year.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Japanese Museum of Commerce at Bangkok.—There has recently been established in this city a museum of Japanese manufactures and products. This institution is under the direction of the Japanese government, which pays all the running expenses, except the salary of the director.

The establishment occupies large and commodious rooms in one of the busiest portions of the commercial city. In these rooms it is proposed to display a sample of every commercial product of Japan. There are a number already on exhibition, and our neighbors of the Far East are making a decidedly favorable showing of their manufactured products. A corps of polite clerks is in constant attendance to assist any who may wish to look over the exhibition, and anyone can order goods from the sample, a per cent. being added to the price mark. This per cent. has been fixed in Japan and is invariable.

In case the purchaser wishes to pay freight himself, the per cent. is simply the commission that goes to the director in place of a salary. If desired, however, the establishment will deliver the goods to the door of the purchaser, adding to the producer's price such a percentage as will cover commission and expenses. All items of expense, whether of postage, cable, freight, or commission, are entered upon the bill of the purchaser. By employing as director a man who has other business interests in Bangkok, the government has been able to secure a valuable agent of successful business experience and wide acquaintance with the people.

The museum has been opened now for six or seven weeks and is proving an increasing success. The oriental merchant has little use for catalogues, price lists, and pictures. He objects to the salesman for the reason that his samples go with him, and he leaves nothing to enable the purchaser to compare the goods delivered with those ordered. Here the samples can be inspected and the goods compared with the samples; the merchant can deal with a firm that is established in his city, and the goods are not to be paid for until he is satisfied that they are what he ordered. The straight-forward manner of fixing the purchasing price appeals to both oriental and occidental.

Orders are accepted for large or small quantities, and the small purchaser gets the advantage of freight rates on the large orders if he is willing to wait. As a result, the patrons of the museum are by no means confined to the mercantile class, and the European population of the city are availing themselves in no small degree of this opportunity of doing business with a splendidly stocked Japanese bazaar.

The trade between Japan and Siam had not assumed proportions sufficient to warrant notice in the annual customs reports of Bangkok until last year, when, as the first fruit of Japan's intelligent endeavor, this trade is reported as \$74,960.—Hamilton King, Consul-General at Bangkok.

Overproduction in Germany.—The Berlin correspondent of The London Daily Mail sends his paper the following report:

"The crisis in the German textile trade is spreading. One manufacturer after another has stopped production for an indefinite time, or has dismissed half his hands and cut down the working hours of the remainder.

"Overproduction, due to the rapid progress of European trade and to the growth of trade in other countries, such as India, which in former years merely supplied the raw material, is the disease afflicting the textile trade. And with overproduction has come a decline in export business with the United States, owing to the protectionist policy of that country.

"In Saxony, some of the carpet makers are only working four hours a week. In central Germany, dismissals on a large scale are reported. Still worse is the state of affairs in Silesia, where dismissals and short hours are combined.

"Nor is western Germany in any better state. The silk weavers of Crefeld have dismissed one-third of their hands, and the rest are working short time. In Aix la Chapelle two thousand hands are out of employment. The only bright spot is the velvet industry, which still keeps up its production.

"From Alsatia in the west to Silesia in the east the cry is the same—overproduction.

"The war has naturally had a bad effect on trade, more particularly on the iron trade. India, for instance, has been constructing numbers of rice mills, and had bought the machines in Thuringia. Since troubles in China arose, this progress has ceased."

In addition to this, I may add, says Ernest L. Harris, consular agent at Eibenstock, that the high price of cotton is causing much distress. Only the other day the spinners of Austria-Hungary, meeting in Vienna, decided to reduce the output by one-sixth. This means that the mills will close down one day per week until next spring. The cause of the whole trouble is the high price of cotton and the impossibility of getting equivalent yarn prices. Many other mills throughout Europe are closing on account of shortage in this article.

Irrigation in Spain.—The consul at Coburg, Mr. Hughes, under date of August 29, 1900, reports:

Spain and France are using about the same area for growing cereals, and yet there is an enormous difference between the harvests yielded by these two countries. The scarcity of water in Spain accounts for this great difference in fertility. The rainfall is very unevenly distributed over the whole peninsula. In the Cantabrian region it will average as high as 2 meters (78·74 inches), while the central table-land and the southern districts often have hardly 75 centimeters (29·53 inches) in a year. There being sufficient river water in Spain, the government is considering the establishment of a regular irrigating system. In the valleys of the Rivers Ebro and Tajo, the watered country yields twelve times as much fruit as the dry. There are very large sections in Spain which need irrigation. The valley of the River Ebro, for instance, is provided with sufficient reservoirs and canals to allow of 236,000 acres to be flooded, while in the valleys of the Guadalquivir, Quadiana and Tajo rivers hardly 86,000 acres in all can be watered. By a royal decree dated May 11, 1900, the country has been divided into seven districts, in each of which the preparatory work has been commenced. The general plan for the construction of reservoirs and canals will probably be finished before the 31st of December, 1900, and will, it is hoped, become a law in the very near future.

German Imports and Exports of Typewriters and Cash Registers.—Under the date of August 27, 1900, Vice Consul-General Hanauer, of Frankfort, reports that during the first six months of the present year Germany imported 299 metric cwts. (32,890 pounds) of typewriters and cash registers, of which 224 metric cwts. (26,640 pounds) were imported from the United States. The value of the total imports in this line was 1,500,000 marks (\$357,000). During the same period, Germany exported typewriters and cash registers to the amount of 110 cwts. (12,100 pounds), of which 86 per cent. went to Austria-Hungary and 10 per cent. to Russia. In view of German imports from the United States, as shown, it seems strange that our manufacturers do not supply Austrian and Russian wants in these lines direct. If they do not make immediate efforts to do so, Austria and Russia will soon be flooded with German imitations of American typewriters and cash registers.

Compressed Fuel.—Writing from Frankfort, August 9, 1900, Consul-General Guenther reports that according to Kuhlow's German Trade Review and Exporter, of Berlin, a syndicate has been formed for the purpose of acquiring a patent for improvements in machinery for agglomerating fuel and the right of granting licenses for the manufacture of artificial fuel. It is proposed, in addition to working machines, to sell such machines to colliery proprietors or others, either for a fixed price or on royalty. The particular briquette proposed to be manufactured by the syndicate will be free from pitch and tar, and, while comparatively smokeless, will give an abundant flame, and will be of a convenient size, averaging about 9,000 to the ton. The briquettes are clean to handle and are not easily fractured. The capital of the syndicate is £15,000 (\$73,998) in £1 (\$4.8665) shares, and the secretary's office is at 2 Clements Inn, London, W. C.

Brushes in Germany.—Vice Consul-General Hanauer writes from Frankfort, August 27, 1900:

During the first six months of this year, the exports of German brushes and sieves (the last being insignificant in amount) reached 6,745,000 marks (\$1,591,310), an increase of 9·2 per cent., as compared with the exports for the same period of the year previous. Great Britain took 45·3 per cent. of the exports; the United States, 6·9 per cent.; Holland, 5·4 per cent.; Argentina, 4·7 per cent.; Switzerland, 4·3 per cent.; Australia, 3·5 per cent.; Austria-Hungary, 2·5 per cent. We are the greatest pork and bristle producers in the world, and can compete in price and quality of brushes with any country. After we have attained German mercantile experience we will win foreign markets in this line.

Consumption of Locomotive Smoke.—Under date of August 14, 1900, Vice-Consul Monaghan, of Chemnitz, reports that a member of the board of general directors of the Royal Saxon Railways has invented a new device for the consumption of smoke given off by locomotives. He claims that it is almost perfect, whether the locomotive is moving or standing still. Certain technical papers say that this device has been added to four locomotives in Chemnitz, and the engineers state that they are much pleased therewith. A locomotive using this new invention and being worked to its utmost capacity saves in one month 28,600 pounds of coal. To equip a locomotive with the device costs about \$25. It can also be applied to stationary engines.

American Railroad Cars in Bavaria.—Vice and Acting Consul-General Hanauer, of Frankfort, writes, September 21, 1900, as follows:

The Bavarian government, which owns the railroads and canals in that state, is having a fine American model car built at the Maschinenbau-Aktien Gesellschaft's works in Nuremberg, for the express train. The woodwork and metal fixtures are furnished by the Pullman Company, which sent out one of its constructors to superintend the building of the car. This would seem to portend that the small old-style cars of Germany are to be replaced by new ones after the commodious American pattern.

German Machinery Exposition in Russia.—Vice Consul-General Hanauer, of Frankfort, under date of September 22, 1900, informs the Department that the Chamber of Commerce of Frankfort calls attention to a preparatory meeting of manufacturers of machinery, to convene this autumn. This convention is to decide upon organizing a machine exposition in Russia. The chambers of commerce in Germany are requested to send delegates.

Commercial University for Cologne.—Mr. Harris, consular agent at Eibenstock, September 1, 1900, reports that a commercial university similar to the one in Leipzig is shortly to be founded in Cologne, Dr. Von Mevissen, a resident of the city, having donated the necessary funds.

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T.. Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Substitute for Gum Arabic.—As is well known, gum arabic, since the war in the Soudan, has become more and more rare, at times even lacking altogether. This, of course, caused the price to rise. A surrogate was sought for and dextrine was selected, which may be regarded as a second-rate adhesive agent and easily spoils. Recently I have succeeded after prolonged experimenting with bone gelatine by means of hydrogen peroxide, sulphurous acid, etc., in finding a process of producing in a simple and ingenious manner a fine mucilage from ordinary joiner's glue, which, owing to its impurities, consisting of alkaline phosphates and earths, acetic acid, lactic acid, ammoniacal salts, albumen, meat extract, fat, iron salts, etc., which latter usually pass into the glue by reason of the iron cylinders used for steaming, possesses very loathsome odors and readily putrefies in solution or at least gelatinizes. This mucilage does not only furnish a substitute for gum arabic but also, by far, excels it in adhesive qualities and odor. It always remains liquid, never spoils and has a pleasant smell of sugar. The production is simply as follows: Dissolve 250 grammes of glue in a liter of boiling water and heat this glue solution in the water bath with a mixture of about 10 grammes of barium peroxide of 75 per cent. BaO_2 and 5 grammes of sulphuric acid (66°) mixed with 115 grammes of water, for about 24 hours. After the time has elapsed, pour off from the barium sulphate, whereby a little sulphurous acid results owing to reduction of the sulphuric acid, which has a bleaching action, as it were, making the glue somewhat paler; thus obtaining an excellent adhesive agent, a whole liter (equals 1 kilogramme) of which costs but 15 pfennige (equal 4 cents), which is certainly cheap. If this solution is mixed, with stirring, and dried upon glass plates in the drying room, a product which can hardly be distinguished from gum arabic is obtained, in which only the pieces of wood are lacking, which may even be mixed in, if desired. Only the reaction, indicated by me, with fluorhydric acid or the percentage of nitrogen, which in the case of glue amounts to 26 per cent., and for gum arabic, hardly is ½ per cent., at once distinguishes the artificial product from the genuine one. An envelope sealed with this mucilage cannot be opened by moistening the envelope, as is often done by unscrupulous persons with somebody else's letters; for this reason it ought to be officially introduced by the Post Office and the envelope factories. I make this mucilage myself and have not yet discovered any drawbacks, but only advantages. It has a somewhat acidulous smell of molasses, remains liquid, clear, and exceedingly firm for months when standing open in a bottle, without cracking when drying. The traces of free acid which it contains prevent the invasion of bacteria, hence all putrefaction. In my opinion dextrine is altogether to be condemned.

I would yet mention that adhesive power of the artificial gum is so enormous that the use of cork stoppers is quite excluded, since they crumble off every time the bottle is opened, so that finally a perfect wreath around the inner neck of the bottle is formed. Only metallic or porcelain stoppers are in place.—Farben Zeitung.

Impregnation of Papers with Zapon Varnish.—For the protection of important papers against the destructive influences of the atmosphere, of water fungi, and light, but especially against the consequences of the process of moulding, Oberstabsarzt Schill has invented and tested for years a process which has been introduced under the name of zapon impregnation.

The first aim of the inventor was the preservation and improvement of manuscripts and old printed matter, but the invention does not only answer this purpose, but it can also be employed in all cases in which the decay of important documents, books, charts, drawings, etc., is to be forestalled; also when the sizing of the paper is to be strengthened and the liability to tear is to be reduced.

It offers a possibility of protecting from decay and destruction plans and sketches which are to be placed in the hands of building foremen, and maps to be used by travelers for some time.

The zaponizing may be carried out by dipping the papers in zapon or by coating them with it by means of a brush or pencil. Sometimes the purpose may also be reached by dripping or sprinkling it on, but in the majority of cases a painting of the sheets will be the simplest method.

Zapon in a liquid state is highly inflammable, for which reason during the application until the evaporation of the solvent, open flames and fires should be kept away from the vicinity. When the drying is finished, which usually takes a few hours where both sides are coated, the zaponized paper does not so easily ignite at an open flame any more or at least not more readily than non-impregnated paper. For coating with and especially for dipping in zapon, a contrivance which effects a convenient suspension and dripping off with collection of the excess is of advantage.

The zapon should be thinned according to the material to be treated. Feebly sized papers are coated with ordinary, i. e., undiluted zapon. For dipping purposes, the zapon should be mixed with a diluent, if the paper is hard and well sized. The weaker the sizing, the more careful should be the selection of the zapon.

For archives purposes, an especially carefully prepared kind of zapon varnish is recommended, which does not render the paper translucent, but imparts to it special softness.

The zapon to be used for coating purposes should be particularly thick, so that it can be thinned as desired. Unsized papers require an undiluted coating.

The thick variety also furnishes an excellent adhesive agent as cement for wood, glass, porcelain, and metals which is insoluble in cold and hot water, and binds very firmly. Metallic surfaces coated with zapon do not oxidize or alter their appearance, since the coating is like glass and only forms a very thin but firmly adhering film, which, if applied on pliable sheet metal, does not crack on bending.

For the preparation of zapon the following directions are given: Pour 20 parts of acetone over 2 parts of colorless celluloid waste—obtainable at the celluloid factories—and let stand several days in a closed vessel, shaking frequently, until the whole has dissolved into a clear, thick mass. Next admix 78 parts of amyl acetate and completely clarify the zapon varnish by allowing to settle for weeks.—Papier Zeitung.

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